8. Information Management

This chapter addresses DON information policy, information requirements definition, information interchange, database management and interoperability and data metrics. The relationship of this chapter with the ITSG is shown in Figure 8-1.

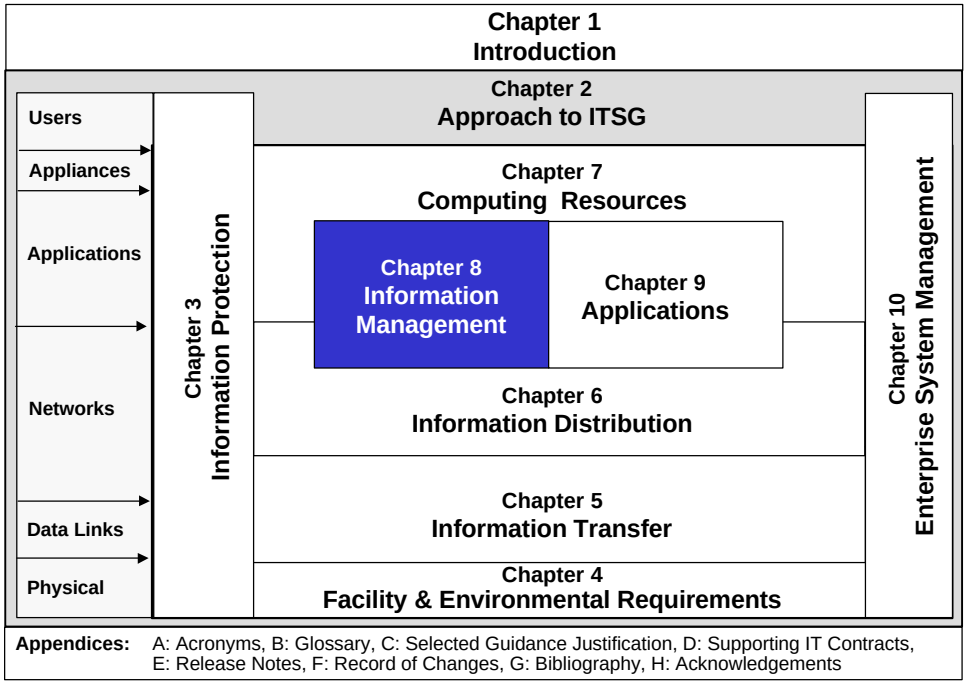

Figure 8-1. ITSG Document Map Highlighting Chapter 8, Information Management

Information is the assembly and presentation of data in a form that is understandable and valuable for conveying knowledge and making decisions. It is the "payload" of the information infrastructure. Information management is critical to the execution of individual Navy and Marine Corps mission functions.

The information challenge in our Navy and Marine Corps operating environments is unparalleled because of required force mobility, unit dispersion, and the multitude of missions. Requirements for the right information at the right time in the correct amount to the right place increase exponentially when the warfighter is placed in a forward area conflict environment. Fleet commanders need and expect high quality information that will enable them to quickly respond to the challenges that confront them. In this environment, information weighs heavily on the outcome and is often a primary determinant of success or failure. This requirement, as stated in Joint Vision 2010, supports information superiority for our warfighters.

Transforming raw data into useful information is the job of information managers (C4ISR, Combat Systems, Logisitics, Personnel, Medical, Acquisition, and Modeling and Simulation). The relationship of information management within the information infrastructure (Facilities, Communications, Hardware, and Software Applications) is shown in Figure 8-2. The capability of today's information systems can produce outcomes of two potential extremes – totally overwhelm the user with unusable information or deliver critically important information in a timely manner. The objective of information management is to maximize the timely delivery of essential information in a usable structure.

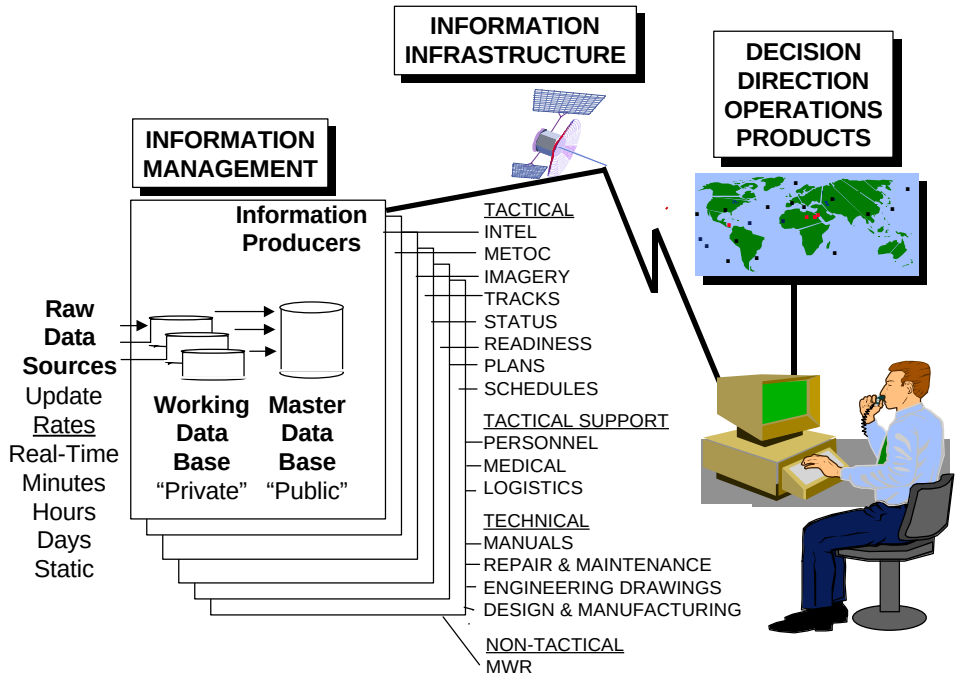

Figure 8-2. Relationship Between Information Management, Information Infrastructure, and Operations

Creating useful information from data involves transformations of the data into multiple media and formats:

- Formatted for transmission over communication links
- Encrypted for security
- Compressed for efficiency
- Structured for storage, retrieval, processing, manipulation and presentation

Each transformation requirement provides an opportunity to stop, delay, attenuate, or corrupt the information. Minimizing the amount of transformations that have to occur is fundamental to providing useful information. Accuracy, precision, and timeliness of information are often best achieved if the information is maintained at the source vice the destination. Operators at the source of the information have a better understanding of the surrounding situation. They, therefore have the greater capability to produce accurate information with higher precision. Today's information technology allows more operators to directly manage the source. This information base can then be shared with remote processors or join with other remote information bases for greatly improved sharing and data interoperability.

This chapter describes the role of information management in the development, maintenance, and implementation of the objective DON enterprise architecture and standards discussed in Chapter 1. The modified DOD Technical Reference Model (TRM) in Figure 8-3 shows that information management involves Basic Network and Information Distribution Services (BNIDS); BNIDS is discussed in Chapter 6.

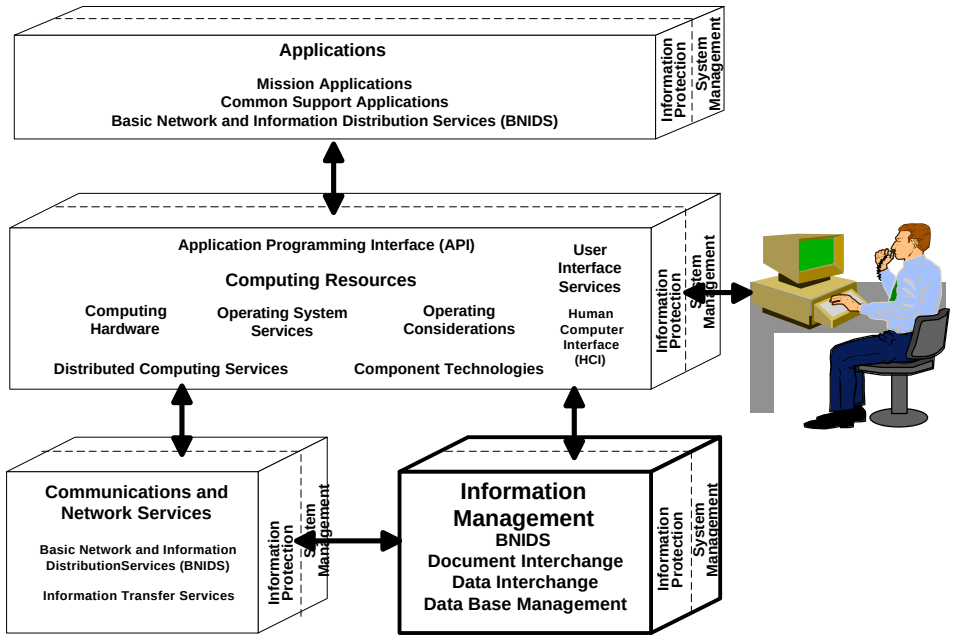

Figure 8-3. Information Management in the Context of the DOD Technical Reference Model

Information management is a process improvement effort that must address information requirements, the aggregation of which become the DON Information Architecture. It also must address information interoperability which is the condition achieved between systems when information or services are exchanged directly between systems and/or their users.

8.1 DOD Policy

8.1.1 Information Interoperability

DOD Directive 4630.5 “Compatibility, Interoperability, and Integration of Command, Control, Communications and Intelligence (C^3I) Systems,” requires interoperability between C^3I and interfacing systems. The draft revision to 4630.5, “Information Interoperability,” currently in staffing, expands the scope beyond C^3I, implements the Clinger-Cohen Act, and directs participation in the Defense Information Infrastructure effort. The Joint Chiefs of Staff (JCS) defines interoperabity as the condition achieved between systems when information or services are exchanged directly and satisfactorily between the systems and/or their users.

8.1.2 Information Management

Basic DoD Information Management Program policy is established in DoD Directive 8000.1, “Defense Information Management (IM) Program.” The directive also assigns implementation responsibilities. Among the policies established are (direct quotes):

- Accurate and consistent information shall be made available to decision makers expeditiously to effectively execute the DoD missions
- Data and information shall be corporate assets structured to enable full interoperability and integration across DoD activities

- Identification and validation of process improvements shall be based on DoD-approved activity models that document functional processes and associated data models that document data and information requirements, including integration of information from other functional areas
- Approved DoD-wide methods, approaches, models, tools, data, information technology, and information services shall be used
- Standard DoD data definitions shall be used for all information systems, to include the interfaces between weapon systems and the information systems
- Information systems shall be based upon a model of information needs
- Design by prototyping, in a generally defined strategy, as the preferred course
- Acquire, to the extent practical, information technology components from the centrally-managed DoD-wide information technology repository

8.1.3 Data Administration

DoD Directive 8320.1, "DoD Data Administration", establishes policy that defines requirements for data standardization and data modeling. DoD Directive 8320.1 applies to all information systems of the Navy and Marine Corps, whether or not these systems share data with other systems. DoD data administration is implemented to (direct quotes):

- Support DoD operations and decision making with data that meets the need in terms of availability, accuracy, timeliness and quality
- Structure the information systems in ways that encourage horizontal and vertical sharing of data in the DoD
- Include procedures, guidelines, and methods for effective standards, modeling, and configuration management
- Implement data administration aggressively in ways that provide clear, concise, consistent, unambiguous, and easily accessible data DoD-wide
- Standardize and register data elements to meet the requirements for data sharing and interoperability among information systems throughout the DoD
- Use applicable Federal, national, and international standards before creating DoD standards

DoD Directive 8320.1 seeks to levy the burden and cost of conversion to DoD standard data, regardless of the origin of the requirement for information on the Military Department responsible for the development of the nonstandard data.

DoD Directive 8320.1 identifies the roles and responsibilities of the Component Data Administrator (CDAd). The DON CDAd is responsible for facilitating the implementation of 8320 policy. The DON CDAd represents the DON at DoD-level data administration committees and working groups.

Best Practices

The DON will participate in the DoD data administration process.

Recommended Implementation

	Current ITSG	Projected ITSG			
Not Recommended	**1999**	**2000**	**2001/2002**	**2003/2004**	**Emerging**
	DoDD 8320.1 DoDD 8320.1-M DoDD 8320.1-M-1	Implementation Plans			
Activities, Platforms, Operational Environments		Information Producers and Data Base Developers			

Table 8-1. Data Administration Implementation

Note

Implementation Plans – the System Commands (SYSCOMs), Project Engineering Offices (PEOs), System Executive Offices (SEOs) and Program Managers (PMs) should ensure that implementation plan(s) support directives and instructions dealing with data acquisition, information management, data administration, and information interoperability.

8.2 Information Architecture

Information requirements are those necessary to accomplish assigned missions. These requirements are the basis for the DON Information Architecture.

There are three types of architectures – operational, systems and technical – identified in the DoD Joint Technical Architecture (JTA). The DoD C4I Integration Support Activity (CISA) C4ISR Architecture Framework provides the rules, guidance, and product descriptions for developing and presenting these respective architectures. Operational architectures are used to establish the Information Exchange Requirements (IERs) necessary for an organization to perform its assigned missions and objectives. These IERs are consistent with the requirements of JV2010 and the mission-to-information requirements mapping required by the Clinger-Cohen Act. System architectures translate operational needs into specific technologies and systems that are compliant with the requirements of the DII/COE. The Technical Architecture Framework Information Management (TAFIM), the JTA, and this ITSG provide the approved technical components for use in systems development.

The Universal Joint Task List (UJTL), provides a listing of tasks associated with Joint warfare. Additional tasks that are component specific are contained in the Navy Task List and the Marine Corps Task List. Theater and Component Commanders use these lists to select Mission Essential Tasks and associate these tasks with conditions (physical, military and civil) that may affect the performance of them. Information on these conditions provides the basis for conducting military operations. Each task or activity has associated essential elements of information that are maintained in databases and provide a foundation for data exchange. Figure 8-4 shows the relationship between mission, activities, and data. The need is to synchronize the databases and develop common data formats afloat and ashore.

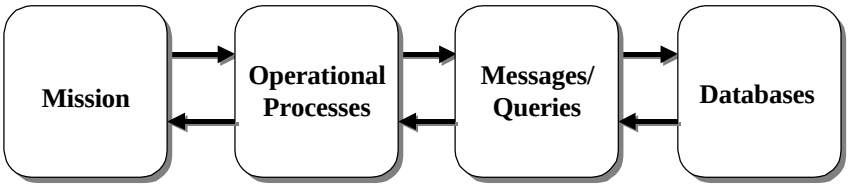

Figure 8-4. Information Requirements Definition

Figure 8-5 depicts an approach for developing a DON Enterprise Information Architecture. Using models to baseline current capabilities provides a practical approach to determine the capabilities of existing system data and databases. Using models to describe the operational data requirements provides an approach to reflect the information requirements of the enterprise.

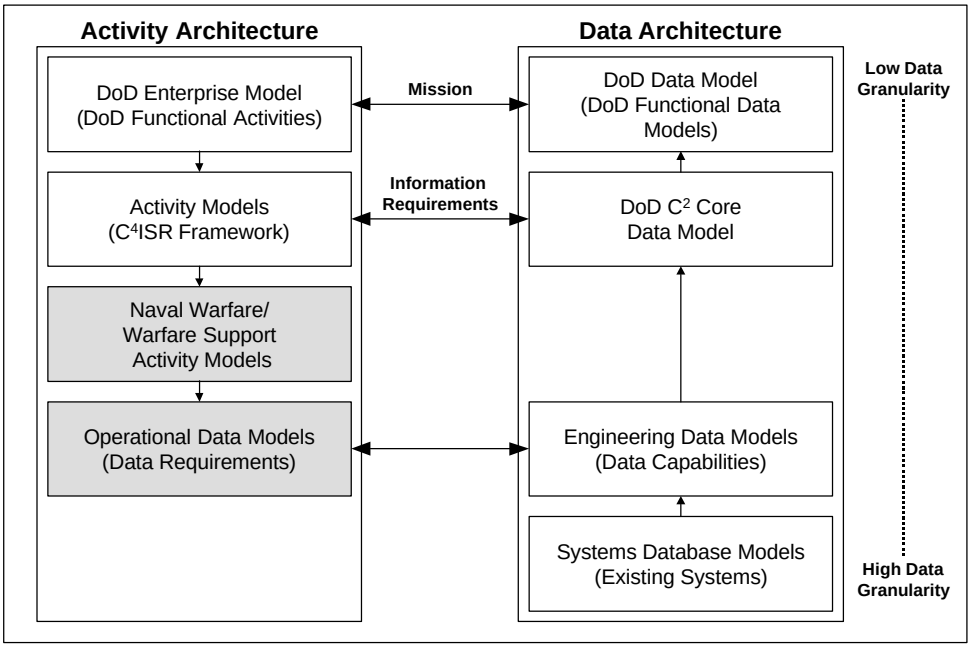

Figure 8-5. Information Architecture

There are two components of the architecture:

- Activity architecture -- decomposes information needs of the enterprise into specific data requirements by using activity models
- Data architecture -- maps existing system database structures and data elements using high level data models

The following describes the two types of modeling which correspond to Activity Architecture and Data Architecture:

Activity Modeling. Enterprise data requirements are developed using Activity Modeling. The activity model is a view of the activities, both automated and manual, that an organization must perform to achieve its mission. Activity models depict the mission area functions of each operational organization. Their primary purposes are to show the information required to support the mission area functions and to identify the functionality required of the mission area applications. They are also used to document and model the activities, processes, and data flows supporting any new system or major update. The

standard format for displaying activities is Integration Definition for Function Modeling (IDEF0) as defined in Federal Information Processing Standard (FIPS) 183.

Activity models have a wide range of uses as shown below:

- Provide a logical representation of related sets of operational activities and their associations
- Provide a means of identifying, capturing, analyzing, decomposing, refining, and documenting operational strategies, rules, and processes
- Act as a set of notations to be defined and manipulated during definition and reengineering of operational functions and processes
- Provide descriptions that enable non-modeling users to understand what functions are involved and assist in their evaluation and improvement
- Provide a basis for defining and justifying data and information requirements
- Provide linkage from organizational missions, strategies, goals, objectives, tactics, and practices to the information systems and data developed to support them

Data Modeling. The data model is for use DON-wide and is developed from the information requirements documented in the activity model. A fully attributed, application-specific data model defines the entities and their data elements, and illustrates the interrelationships among the entities. The data models identify the logical information requirements and metadata that form a basis for physical database schemata and standard data elements. Once implemented, the data is shared using approved information exchange standards. The standard format for displaying a data model is IDEF1X as defined in FIPS 184.

Best Practices

Develop an information architecture responsive to Navy and Marine Corps mission needs that supports the information superiority goals of Joint Vision 2010 and the information initiatives of the Clinger-Cohen Act. Use the C4ISR Architecture Framework guidance and DoD DII/COE principles, guidelines and methodologies in constructing and documenting information architectures.

Recommended Implementation

	Current ITSG	Projected ITSG			
Not Recommended	**1999**	**2000**	**2001/2002**	**2003/2004**	**Emerging**
	DII/COE TAFIM/JTA	Implementation Plans			
Activities, Platforms, Operational Environments		Data Base Developers			

Table 8-2. Information Architecture Implementation

Note

Implementation Plans – the SYSCOMs, PEOs, SEOs and PMs should ensure that implementation plan(s) support directives and instructions dealing with data acquisition, information management, data administration, and information interoperability.

8.3 Information Interchange

Information interchange supports the flow of information throughout the network with minimum transformation. These services provide a set of integrated capabilities that the application software entity accesses to obtain standard common operating environment services. The characteristics of the application support services are transparent to the mission and common support applications developer.

8.3.1 Push versus Pull

Basic Network and Information Distribution Services (BNIDS) (Chapter 6) provide the mechanism for information dissemination. The method of dissemination often drives the format and media of the information packages. Four architectural paradigms have been used to model information dissemination and are illustrated in Figure 8-6.

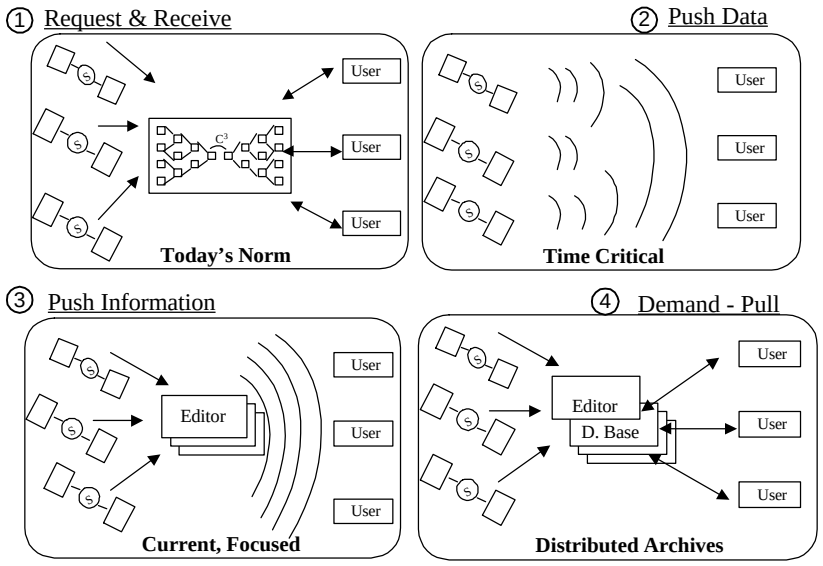

Figure 8-6. Information Dissemination Architectures

1. **Request and Receive.** Each request for data is reviewed and prioritized at the appropriate level in the information support hierarchy as the request travels through the chain of command. Resulting data is delivered back down the chain, often by reversing the steps involved in requesting it. This method is especially appropriate where scarce resources must be rationed, or where special security protection is required for an information collector. Example: sending a Request for Intelligence Information (RII) .

2. **Push Data.** Sensors and data collectors distribute data directly to users, often in a raw or unprocessed condition. The data users must be equipped to receive and process the pushed data. This method is especially appropriate for simple data which is highly time

critical or perishable. Examples: navigation data furnished via global positioning system, direct dissemination of ELINT reports.

3. **Push Information.** Sensor and data collector outputs are fused by an editor into a composite representation; the editor then selects and forwards appropriate information in each of many channels. Each channel is oriented toward a particular group of users and operations. The editor's function is to ensure that the information being forwarded through the channels is correct, complete, germane to the users, and timely. This method is especially appropriate for complex situational data that is time critical or perishable. Example: a televised weather report or news broadcast.

4. **Demand Pull.** This is an on-line reference service. Large archives of information are actively managed by editors; the archives are stored on distributed servers directly accessible by information users. Users directly access the archives when they need archival information. This method is especially appropriate when non-time critical reference data must be made available to a large number of distributed users. Example: a commercial system such as America On Line.

The goal of a Demand Pull information dissemination system is to make a large volume of (archival) data available to a large number of users at user discretion. Certain issues arise which must be addressed by a successful Demand Pull information dissemination system and they are addressed in other chapters of this ITSG.

User Human Computer Interface. The man/machine interface presented to users of the Demand Pull system must be simple, intuitive, predictable, and not require extensive knowledge or training on the part of the user. (Chapter 7)

User Client Terminal. The user terminal equipment must be relatively low cost and multi-functional. (Chapter 7)

Communication Connectivity. Communications connectivity and bandwidth connecting users to the Demand Pull system must be able to support the bursty, high data rate communications required to support user operations. (Chapter 5)

Server Capacity. Server capacity must be sized to handle bursts in level of demand by users, to prevent 'locking out' users from the archived information at critical periods of user operations. (Chapter 7)

Multimedia. Requirements for providing Multimedia archives (text, voice, graphics, sound, images, video, animation) must be defined early because of the impact they have on communications, server capacity, user terminal equipment, user man/machine interface, data modeling, indexing, and search and retrieval. (Chapter 9)

Indexing. Indexing has two distinct parts. First is the location or address of the site (command) where desired information is located, and second is the titling of the information by the site. (Chapter 6)

Search and Retrieval. Browsers must be able to perform effective searches using the search engines and indexes of the archive, and must be able to easily retrieve found information, meeting the user's expectations for quantity, quality, appropriateness, and timeliness of information. (Chapter 6)

Each of the above four described dissemination architectures has wide applicability in both civilian and military situations. Each of the four is appropriate for particular operational and support situations. In the military C^4ISR context, new time critical information has to be pushed. Other push-information situations may include ships in EMCON, or data which is to be distributed to a large number of users, (e.g. ALNAV). Smart push information can be as effective with less communications in certain crisis situations.

8.3.2 Information Discipline

This section discusses information discipline in terms of requirement, scope, technical disciplines, operational disciplines, and the special case of bandwidth management. The objective of information discipline is to assure optimum use of information resources and investments.

8.3.2.1 Requirement

The ability to generate and move information has increased many thousand-fold over the past 20 years. Navy and Marine Corps operations have become more reliant on information technology, the sheer volume of the information threatens to overwhelm our information capability. Unfortunately, the current capability to generate information far exceeds the ability to control and use it effectively. The principal requirement is to manage these volumes of information across the networks to ensure availability during times of crisis. Sets of rules and procedures are required to govern information to prevent gridlocks.

Given this operational significance, information discipline must be standardized and codified with rules of operation and levels of control, similar to other functional disciplines.

8.3.2.2 Scope

The scope of this information discipline effort is extraordinarily wide because virtually all functions rely on the information infrastructure. It includes both the qualitative and quantitative aspects of information operations. It ranges from the standards for information exchange to the operation of the networks for decision support. Both technical and operational disciplines are included.

8.3.2.3 Technical Disciplines

Technical interface standards, which define rules for electronic connectivity and interoperation, represent specialized forms of information discipline. Software standards extend the standards disciplines to the logical levels of signaling, processing, and display. Collectively, these evolving rules and methods represented by technical standards have enabled the information revolution – from international telephone and telegraph networks, ARPANET and the INTERNET to emerging global military networks.

8.3.2.4 Operational Disciplines

With the exception of some physical limitations and the disciplines associated with selected communications and warfare doctrines, the subject of information discipline is undefined. Some communications control measures, such as release authority, precedence and minimize, have been adapted to C4I networks, but they can have only marginal effect unless implemented consistently across the DON enterprise. Where they are implemented, such measures typically produce an abrupt change from saturation to under-utilization. Neither situation represents an optimum use of

resources. In addition, most measures are simply not relevant in a peacetime network where free flowing e-mail messages have become more prevalent than telephone calls. New concepts and methods of information control are required.

8.3.2.5 Methods

While systems were fragmented and used multiple standards, their diversity precluded effective real-time management. However, technologies that enable automated networking of functions can also support selective automation of network management and resultant information discipline. Experience in major exercises and the Gulf War clearly indicate a need for automated, real time monitoring and control of information flows. These methodologies must be built into the support and they must be able to accurately categorize and identify sources of information traffic.

In addition to automating control methods, emphasis must be placed on improving the discipline of originators and users. Experience has proven that once the information is in the networks, controls are of marginal use and can result in serious errors and omissions. The most effective point of information control is at the source.

Most systems and networks already include self-monitoring modules which keep a variety of statistics. These should be modified and expanded to support regional and global analysis and control.

8.3.2.6 Data Rate Management

Data rate refers to the information transfer capacity of a communications medium. It is typically expressed in number of data bits per second. It is often referred to as “bandwidth” even though bandwidth is actually the size of the frequency band given to a communication channel. Typically, the larger the frequency band, the higher the data rate. Hence “data rate’ and “bandwidth” are frequently used interchangeably even though they are not technically the same. Evolving communications and switching technologies have enabled tremendous increases in the effective bandwidth of most media. The degree of increase is shown in Figure 5-3 (Chapter 5), “Evolution of LAN and WAN Data Throughput”, and Table 5-1, “Data Rate Designations”. These figures reflect the technological leaps in data throughput, both in recent implementations and in projections.

On the surface, such increases in capacity would indicate information transfer capabilities that exceed any possible demand and preclude the kind of information gridlocks experienced in previous conflicts. However, that view is superficial in the context of command and control because it disregards factors that collectively increase the need for bandwidth management. These factors include:

- Limitations increase at forward echelons, which need concise, timely information
- Capability disparities exist among interfacing networks and nodes
- Numbers of input and output nodes exponentially increasing
- Information flow controls are often ineffective
- Information generation controls are non-existent
- Excess information extends the decision process
- Excess and conflicting information increases the probability of serious error
- Cost per bit is decreasing, but total information costs are rising

These factors, along with increasing pressures to treat information as a resource, combine to make effective data rate management a higher priority. In the past, communications doctrine and related control mechanisms allocated the limited amount of available bandwidth. However, the effectiveness of those mechanisms deteriorated over time. They were marginally effective in the Gulf War and are irrelevant in many of the network applications today.

New information control and management techniques are required to ensure that the information being generated and transferred is mission relevant, cost efficient and operationally effective. Fortunately, many of the systems being developed have capabilities that can achieve these goals. It is necessary, however, that the management requirements be defined and requisite control measures implemented along with the systems and networks. To this end, future information system development and integration will include the following steps:

- Redefinition of global flow control requirements
- Integration of global control requirements into systems definitions
- Ability of information users to regulate inputs to their systems
- Ability of information producers to meter production and transmission on a precedence basis

8.3.3 Data Interchange Services

Data Interchange Services provide support for the interchange of information between applications, and to and from the external environment. Though areas specific to vertical industry groups are not mentioned in this document, two areas of general applicability are discussed:

- Document Interchange
- File formats

8.3.3.1 Documents

Although the prevailing medium for business documents, paper imposes constraints on document management and control. Document management solutions integrate processes, people, and technology to optimize and automate what were, historically, paper-based business processes. As technology has become more available, the concept or definition of a document has changed. The TOG defines the term document as “a set of information, organized as a unit and intended for human perception.” Ultimately, a document is some amount of structured information that users create, store, retrieve, or manipulate.

Electronic documents often consist of data, text, graphics, images, voice, and video. Consequently, creating, processing, and managing electronic documents encompass many technologies, including imaging, multimedia, databases, text databases, text retrieval, document interchange standards, electronic messaging, and workflow management.

Business documents of an administrative and management nature may be developed and maintained in commercially available word processing, spreadsheet, and presentation software and successfully interchanged and read using format conversion capabilities of these software packages.

Technical documents, such as operations, maintenance, and training publications, are created by various industry and government activities, and delivered and life-cycle maintained with their associated equipment, weapons systems, and platforms. These technical manuals often are version controlled and configuration managed in connection with their associated equipment.

These technical publications should be created, managed, distributed, and used in digital electronic formats suitable for their highly structured technical content and long expected life cycle. The DoD Continuous Acquisition and Lifecycle Support (CALS) initiative has adopted the Standard Generalized Markup Language (SGML) (ISO 8879) as the preferred data standard for technical publications and has defined a military profile for its use within DoD in MIL-PRF-28001.

Best Practices

Commercially available office document software (word processing, spreadsheet, and presentation software), and its embedded translation and conversion functionality, should be used for business, administrative, and management document exchange among disparate environments.

All new technical manuals (TMs), Electronic Technical Manuals (ETMs), and Interactive Electronic Technical Manuals (IETMS) will be acquired in Standard Generalized Markup Language (SGML) format in accordance with MIL-PRF-28001. Proper creation of a document in SGML requires a Document Type Definition (DTD), an SGML data construct defining the structure and content of the type of document to be created as well as the definitions and rules for applying SGML in the authoring process. DTDs are complex and costly to develop but may be created to satisfy a broad range of documents. For this reason, authors and contractors should be encouraged to use existing Document Type Definitions (DTDs) for all TMs/ETMs/IETMs. Navy DTDs are currently stored in the Navy DTD/FOSI Repository (http://navycals.dt.navy.mil/dtdfosi/repository.html).

TM/ETM/IETM delivery to the Government must include the SGML master document, the associated DTD and style sheets, FOSIs (Formatting Output Specification Instance, per MIL-PRF-28001), and filter codes necessary to produce the desired presentation to users. Naval activities are encouraged to also request delivery of a DTD Data Dictionary, defining the meaning of SGML tags used, and a Tagging Conventions document, describing the rules for applying each SGML tag, especially if new or custom DTDs are being used. The information contained within the Dictionary and Conventions documents will be helpful in the maintenance and revision of the TMs and should also be provided to the Navy DTD/FOSI Repository.

Highly dynamic IETMs, i.e., electronic documents whose content is database structured rather than linear or paged and whose presentation is highly dependant on user and data interaction, should also be developed in accordance with MIL-PRF-28001 (SGML). The DTD presented in MIL-PRF-87269 should be used as a guide in the absence of other suitable DTDs. The user interface and presentation format for these IETMs should be developed in accordance with MIL-PRF-87268.

Recommended Implementation

	Current ITSG	Projected ITSG			
Not Recommended	**1999**	**2000**	**2001/2002**	**2003/2004**	**Emerging**
	SGML CALS PostScript SPDL, PDF	SGML XML CALS	SGML XML CALS	SGML XML CALS	
Activities, Platforms, Operational Environments		All			

Table 8-3. Document Exchange Standards

- Standard Generalized Markup Language (SGML) is used for describing both the structure and content of documents. HyperText Markup Language (HTML), an application of SGML, is a current evolving convention for documents on the World Wide Web (WWW).
- Continuous Acquisition and Lifecycle Support (CALS), a Department of Defense initiative, mandates that drawings, technical manuals, and other technical data be created and delivered in standard digital forms. CALS has defined specifications for the exchange of digital data.
- PostScript, Standard Page Description Language (SPDL), and the Portable Document Format (PDF) by Adobe Systems Inc. are acceptable final-form representations for documents. Word processor formats are also acceptable for administrative and management documents.

8.3.3.2 File Formats

File formats are formal structures of file records and layouts that are recognizable and usable by various related products. As a product utility becomes prominent in the industry, other tools and products tend to include the capability to access, use, and create files in the same format as those used by the prominent product.

Note that the use of “file” and “document” in this context is not necessarily text or character-based data. All types of data and media are addressed. Task organization commanders should specify the software file formats to be used during an operation which reflects the common denominator fielded.

The purpose of establishing policy for file formats is not to inhibit product selection but to establish a leverage point for file sharing across the enterprise. Standards are addressed first generally and then by five DON data exchange areas that have specific file formatting standards requirements.

- Geospatial Data Interchange
- Imagery Data Interchange
- Product Data Interchange
- Atmospheric Data Interchange
- Oceanographic Data Interchange

Best Practices

Select products that support the ability to read (import) and create (export) file formats (Table 8-4).

Recommended Implementation

Document Type	Standard/Vendor Format	Recommended File Name Extension	Reference
Plain Text	ASCII Text	.txt	
Compound	Acrobat 2.0	.pdf	Adobe Inc.
Business Document	HTML 2.0	.htm, .html	IETF
	MS Word 6.0	.doc	Microsoft
	MS Word 97		
	Rich Text Format	.rtf	
	WordPerfect 5.2	.wp5	WordPerfect
Briefing	Freelance Graphics 2.1	.pre	IBM
Presentation	MS Powerpoint 4.0	.ppt	Microsoft
	MS Powerpoint 97		
Spreadsheet	Lotus 1-2-3 Release 3.x	.wk3	IBM
	MS Excel 5.0	.xls	Microsoft
	MS Excel 97		
Graphics Imagery	CGM		MIL-PRF-28003, Computer Graphics Metafile (CGM)
	JFIF	.jpeg	Joint Photographic Expert Group (JPEG)
Audio	Wave (WAV)	.wav	
	Audio-Video Interleaved	.avi	
	Audio UNIX (AU)		
Video	MPEG, MPEG2		Motion Picture Experts Group (MPEG)
Internet	HTML 4.0	.htm, .html	IETF
Virtual Reality Model	VRML 2.0	.vmr	Virtual Reality Modeling Language (VRML97, ISO/IEC14772)
Compressed	Zip 2.04	.zip	PKWARE Inc.

Table 8-4. File Formats

Notes

- Compound documents contain embedded graphics, tables, and formatted text. Object Linking and Embedding (OLE) complicates document interchange. Note that not all special fonts, formatting, or features supported in the native file format may convert accurately.

- The current World Wide Web Consortium (W3C) recommendation for HTML is HTML 4.0. HTML 4.0 adds widely deployed features such as tables, applets and text flow around images, superscripts, and subscripts, while providing backwards compatibility with the existing HTML 3.2 standard. (See Section 6.7 for discussion of web standards.)
- VRML 2.0 was improved and adopted as an international specification, VRML97 (ISO/IEC 14722) in December 1997. (See Section 6.7 for discussion of web standards.)
- Technical manuals should be created and delivered to the Navy in MIL-PRF-28001 (SGML). Technical manuals will be stored and managed in SGML in appropriate document management databases and repositories. HTML and XML are limited applications of SGML and are to be used primarily for distribution and presentation of technical manuals to users. Ideally, SGML source data will be converted to HTML for distribution and view.

Desired Form	**Text Standards & Specs**
Electronic Technical Manuals (ETMs)	SGML per MIL-PRF-28001 Use existing DTD or Use new DTD & Request delivery of DTD
Interactive Electronic Technical Manuals (IETMs)	SGML per MIL-PRF-28001 Use MIL-PRF-87269 as guide to DTD User interface per MIL-PRF-87268

Table 8-5. Digital Technical Data Standards for Technical Manual Creation.

Graphics	**Graphics Standards and Specifications**
2-D vector graphics for illustrations & TMs	CGM per MIL-PRF-28003
2-D graphics for hyperlinked illustrations	CGM Level 4 per ATA 2100 V 2.3
Raster (bitmapped) images	MIL-PRF-28002 Type 1 – CCITT.G4

Table 8-6. Graphics Standards for Technical Manual Creation.

Legacy Form	Desired Conversion	Standards & Specs
Technical Manuals	Conversion to SGML	SGML per MIL-PRF-28001 Use existing DTD or Use new DTD & Request delivery of DTD
	Conversion to HTML (Preferred method; supports life cycle management of the converted TM)	Convert first to SGML per MIL-PRF-28001 Use existing DTD or Use new DTD & Request delivery of DTD and Convert SGML to HTML and Deliver SGML, DTD, and HTML
	Conversion to HTML (Alternate method; life cycle management of TM may be difficult due to instability of HTML DTD)	Convert direct to HTML per existing version of HTML DTD and Deliver HTML and the HTML DTD used
	TM Conversion to Raster	PDF per Adobe Systems, Inc or PDL or NIRS/NIFF per Type 3 MIL-PRF-28002 and Indexing per MIL-M-29532
Graphics	Conversion of hardcopy graphics/aperture cards to raster	C4 (JEDMICS) per MIL-PRF-28002 Type 4 or NIFF per MIL-PRF-28002 Type 3
	Conversion of hardcopy or raster graphics to vector	CGM per MIL-PRF-28003
	Conversion of hardcopy or raster graphics to vector with hyperlink capability	CGM, Level 4, per ATA 2100 V2.3

Table 8-7. Digital Technical Data Standards for Legacy Data Conversion

- The following additional standards are recommended for MPEG audio:
  - ISO/IEC 11172-1: 1993 - Encoding of moving pictures and associated audio for digital storage media at up to about 1.5 Mbits/s—Part 1: Systems
  - ISO/IEC 11172-3: 1993 - Encoding of moving pictures and associated audio for digital storage media at up to about 1.5 Mbits/s—Part 3: Audio

    - ISO/IEC 11172-3/Cor. 1: 1995 - Encoding of moving pictures and associated audio for digital storage media at up to about 1.5 Mbits/s—Part 3: Audio Technical Corrigendum.
- The following additional standards are recommended for MPEG2 audio:
    - ISO 13818-1: 1996 - Generic Coding of Moving Pictures and Associated Audio Information - Part 1: Systems
    - ISO 13818-3: 1995 - Generic Coding of Moving Pictures and Associated Audio Information - Part 3: Audio.
- The following additional standards are recommended for MPEG video:
    - ISO/IEC 11172-1: 1993 Coding of moving pictures and associated audio for digital storage media at up to about 1.5 Mbits/s—Part 1: Systems
    - ISO/IEC 11172-1: 1993/Cor. 1:1995 Coding of moving pictures and associated audio for digital storage media at up to about 1.5 Mbits/s—Part 1: Systems Technical Corrigendum 1
    - ISO/IEC 11172-2: 1993 Coding of moving pictures and associated audio for digital storage media at up to about 1.5 Mbits/s—Part 2 Video
- The following additional standards are recommended for MPEG2 video:
    - ISO 13818-1: 1996 - Generic Coding of Moving Pictures and Associated Audio Information - Part 1: Systems
    - ISO 13818-2: 1996 - Generic Coding of Moving Pictures and Associated Audio Information - Part 2: Video

8.3.3.2.1 Geospatial Data Interchange

Geospatial services are a collective name for Mapping, Charting, and Geodesy (MC&G) services.

Best Practices

DON navigation and C4I systems, which display cartography, shall be capable of using both National Imagery and Mapping Agency (NIMA) and Electronic Chart Digital Information System (ECDIS) standards.

Recommended Implementation

	Current ITSG	Projected ITSG			
Not Recommended	**1999**	**2000**	**2001/2002**	**2003/2004**	**Emerging**
	MIL-STD-2411 MIL-STD-2407 MIL-STD-2401 DX-90	MIL-STD-2411 MIL-STD-2407 MIL-STD-2401 DX-90	MIL-STD-2411 MIL-STD-2407 MIL-STD-2401 DX-90	MIL-STD-2411 MIL-STD-2407 MIL-STD-2401 DX-90	
Activities, Platforms, Operational Environments		Developers & Engineers			

Table 8-8. Geospatial Service Standards

For mapping, charting, and geodesy (MC&G) services, collectively known as geospatial services, the following standards are recommended:

National Imagery and Mapping Agency (NIMA) Standards

- MIL-STD-2411, Raster Product Format (RPF) - DoD Military Standard used by the National Imagery and Mapping Agency (NIMA) to format raster-based digital products (e.g., Compressed Arc Digitized Raster Graphics (CADRG), Controlled Image Base (CIB), and Digital Point Positioning Data Base (DPPDB)), and is based on National Imagery Transmission Format Standard (NITFS) (MIL-STD-2500A) described below.
- MIL-STD-2407, Interface Standard for Vector Product Format (VPF) - DoD format for NIMA's vector-based products used by geographic information system (GIS) and other DoD systems. VPF standard products include Vector Map (VMap) Levels 0-2, Urban Vector Map (UVMap), Digital Nautical Chart (DNC), VMap Aeronautical Data (VMap AD), Vector Product Interim Terrain Data (VITD), Digital Topographic Data (DTOP), Littoral Warfare Data (LWD), and World Vector Shoreline Plus (WVS+).
- MIL-STD-2401, World Geodetic System 84 (WGS-84) 21 March 1994 - DoD's standard global reference system developed by the DMA. WGS-84 is employed by the NAVSTAR Global Positioning System (GPS) and modern weapons systems. Latitude and longitude data shall use WGS-84 in accordance with CJCSI 3900.01.
- For all other MC&G services (e.g., Digital Terrain Elevation Data (DTED), Digital Bathymetric Database (DBDB)) not captured in the above standards the products in NIMAL 805-1A, NIMA GGI&S List of Products and Services, January 1997 shall be used.

Electronic Chart Digital Information System (ECDIS) Standards – Controlled by International Maritime Organization/International Hydrographers Organization (IMO/IHO)

- DX90 is an interface standard for vector-based cartography subscribed to by all hydrographic agencies worldwide (including National Ocean Survey (NOAA, NOS)), except NIMA. It is functionally equivalent to VPF. The specific database for storage of DX90 data is specified in IHO approved standards (Pubs S-52 and S-57).
- NOAA NOS produces products in BSB (raster specifications) that now include charts of nearly all the coastal areas of the United States.

8.3.3.2.2 Imagery Data Interchange

The NITFS is a DoD and Federal Intelligence Community suite of standards for the exchange, storage, and transmission of digital imagery products. NITFS provides a package containing information about the image, the image itself, and optional overlay graphics. It was developed and mandated by ASD Command, Control, Communications, and Intelligence (C3I) for the dissemination of digital imagery from overhead collection platforms. Guidance on applying the suite of standards can be found in MIL-HDBK-1300A.

Best Practices

Not provided at this time.

Recommended Implementation

	Current ITSG	Projected ITSG			
Not Recommended	**1999**	**2000**	**2001/2002**	**2003/2004**	**Emerging**
	MIL-STD-2500A MIL-STD-188-196 MIL-STD-198-189 MIL-STD 2301 CALS MIL-PRF-28002 MIL-STD-188.198A	MIL-STD-2500A MIL-STD-188-196 MIL-STD-198-189 MIL-STD 2301 CALS MIL-PRF-28002 MIL-STD-188.198A	MIL-STD-2500A MIL-STD-188-196 MIL-STD-198-189 MIL-STD 2301 CALS MIL-PRF-28002 MIL-STD-188.198A	MIL-STD-2500A MIL-STD-188-196 MIL-STD-198-189 MIL-STD 2301 CALS MIL-PRF-28002 MIL-STD-188.198A	
Activities, Platforms, Operational Environments		Developers & Engineers			

Table 8-9. Imagery Service Standards

The following standards are recommended for secondary imagery dissemination:

- MIL-STD-2500A, National Imagery Transmission Format (Version 2.0) for file format
- MIL-STD-188-196, Bi-Level Image Compression
- MIL-STD-188-199, Vector Quantization Decompression
- ISO/IEC 8632: 1992, Computer Graphics Metafile (CGM) as profiled by FIPS 128 and MIL-STD-2301
- CALS MIL-PRF-28002, Raster Graphics Representation in Binary Format
- ISO/IEC 10918-1: 1994, Joint Photographic Experts Group (JPEG) as profiled by MIL-STD-188-198A. Although the NITFS uses the same ISO JPEG algorithm as recommended in Section 2.2.2.1.4.2, the NITFS file format is not interchangeable with the JFIF file format.

8.3.3.2.3 Product Data Interchange

These standards establish data formats for interchanging product description data. These data include not only a graphical depiction, but also manufacturing process information such as materials and surface finishing. Product data also include technical manuals, operating manuals, repair and maintenance guides, training manuals and materials, engineering drawings, parts lists and breakdown structure, and many other data relating to the concept, design, production, delivery, life cycle support and disposal of Navy products.

Best Practices

Not provided at this time.

Recommended Implementation

Standards Table 8-10 presents standards for product data interchange. The DISA Center for Standards uses the following convention to describe the product data interchange specifications:

- National Public Consensus NPC
- International Public Consensus IPC
- Government Public Consensus GPC

Standard Type	Sponsor	Standard	Standard Reference	Status DoD (Lifecycle)
NPC	ANSI/US PRO	Digital Representation for Communication of Product Definition Data (revision and redesignation of ANSI/ASME Y14.26M-1989) (Formerly IGES)	ANSI/US PRO/ IPO 100-1996	Adopted (Approved)
GPC	NIST	Initial Graphics Exchange Specification (IGES) (adopts ASME/ANSI Y14.26M-1989) (IGES ver. 4)	FIPS PUB 177:1992	Adopted (Approved)
IPC	ISO/IEC	Standard for the Exchange of Product Model Data (STEP), Part 1: Overview and Fundamental Principles (formerly Product Data Exchange Specification (PDES))	10303-1:1994	Adopted (Approved)
IPC	ISO/IEC	Standard for the Exchange of Product Model Data (STEP), Part 11: The EXPRESS Language Reference Manual (formerly PDES)	10303-11:1994	Adopted (Approved)
IPC	ISO/IEC	Standard for the Exchange of Product Model Data (STEP), Part 21: Implementation Methods: Clear Text Encoding of the Exchange Structure	10303-21:1994	Adopted (Approved)
IPC	ISO/IEC	Standard for the Exchange of Product Model Data (STEP), Part 31: Conformance Testing Methodology/Framework: General Concepts	10303-31:1994	Adopted (Approved)
IPC	ISO/IEC	Standard for the Exchange of Product Model Data (STEP), Part 41: Integrated Generic Resources: Fundamentals of Product Description and Support	10303-41:1994	Adopted (Approved)
IPC	ISO/IEC	Standard for the Exchange of Product Model Data (STEP), Part 42: Integrated Generic Resources: Geometric and Topological Representation	10303-42:1994	Adopted (Approved)
IPC	ISO/IEC	Standard for the Exchange of Product Model Data (STEP), Part 43: Integrated Generic Resources: Representation Structures	10303-43:1994	Adopted (Approved)
IPC	ISO/IEC	Standard for the Exchange of Product Model Data (STEP), Part 44: Integrated Generic Resources: Product Structure Configuration	10303-44:1994	Adopted (Approved)
IPC	ISO/IEC	Standard for the Exchange of Product Model Data (STEP), Part 101: Integrated Application Resources: Draughting	10303-101:1994	Adopted (Approved)
IPC	ISO/IEC	Standard for the Exchange of Product Model Data (STEP), Part 201: Application Protocol: Explicit Draughting	10303-201:1994	Adopted (Approved)
IPC	ISO/IEC	Standard for the Exchange of Product Model Data (STEP), Part 203: Application Protocol: Configuration Controlled Design	10303-203:1994	Adopted (Approved)
GPC	DOD	Digital Representation for Communication of Product Data: IGES Application Subsets and IGES Application Protocols	MIL-PRF-28000	Adopted (Approved)
GPC	DOD	Automated Interchange of Technical Information (Life cycle logistic support of weapon systems)	MIL-STD-1840B of 11/3/1992	Adopted (Approved)
GPC	DOD	Markup Requirements and Generic Style Specification for Electronic Printed Output and Exchange of Text	MIL-PRF-28001C May,1997	Adopted (Approved)
GPC	DOD	Requirements for Raster Graphics Representation in Binary Format (Group 4 Raster Scanned Images)	MIL-PRF-28002	Informational (Approved)
NPC	ANSI/US PRO	IGES 5.2, Initial Graphics Exchange Specification (Replaces ANSI/ASME Y14.26M-1989)	US PRO/IPO-100 (Nov 1993)	Informational (Approved)

Standard Type	Sponsor	Standard	Standard Reference	Status DoD (Lifecycle)
IPC	ISO/IEC	Part Libraries, About 10 Parts in Progress	13584-XX work in TC184/SC04	Informational (Draft)
GPC	NIST	Initial Graphics Exchange Specification (IGES): v. 5.2 OR 6.0	FIPS PUB 177-1 (future)	Informational (Formative)
GPC	DOD			
GPC	DOD			
NPC	ANSI/ASME			

Table 8-10. Product data interchange standards

Notes

- The DoD/CALS Initial Graphics Exchange Specification (IGES) standard, MIL-PRF-28000, is preferred for CAD illustrations, engineering drawings, geometry for numerical control manufacturing, and 3-D Piping information in IGES. The standard is optional for technical manual illustrations. The CALS standard for Computer Graphics Metafile (CGM), MIL-PRF-28003 is preferred for technical manual illustrations. Table 8-11 provides guidance.

Application	Standards & Specs
2-D graphics for use in CAD	IGES V5.3 per MIL-PRF-28000 Class II or STEP per ISO 10303 AP201 or AP 202
Product data CAD/CAM/CAE 3-D vector Product Model	Native CAD format and Neutral format per, MIL-PRF-28000, or IGES per ASME Y14.26 IGES Version 5.3 or STEP per ISO 10303
Ship Design	STEP per following: NSRP Doc 0424 Piping AP NSRP Doc 0425 Electrical/Cableway AP NSRP Doc 0426 HVAC AP NSRP Doc 0428 Outfit and Furnishings AP NSRP Doc 0429 Ship Structure AP

Table 8-11. Product Data Creation

- The IPO Electrical Applications Committee (AEC) Layered Electrical Products Application Protocol (LEP AP) is the CALS preferred IGES specification for representation of electrical products.
- The ISO 10303 Standard for the Exchange of Product Model Data (STEP) standard is a set of interrelated application profiles that define a vocabulary and syntax for the exchange of product data. The scope of ISO 10303 encompasses all aspects of product data that may be collected and exchanged for any product throughout the life cycle. In its current state, ISO 10303 primarily addresses the exchange of material and shape data. ISO 10303 is a standard designed for expansion. As such, a large part of its initial content lays in the conceptual framework from which any topic area or product data may be standardized to exchange data.
- Specific applications included in the current version of STEP concern the exchange of 2-D drafting data (AP 201 Explicit Draughting, AP 202 Associative Draughting) and the exchange of configuration controlled 3-D design data (AP 203 Configuration Controlled Design). Interoperability of data among these application protocols cannot be assured as this has not yet been a design criterion of the STEP standards community. Much of the applications for STEP are still being defined in the form of a number of Application Protocols (APs) still under development.

Related standards. The following standards are related to product data interchange or product data interchange standards:

- MIL-HDBK-1300A, NITFS.
- MIL-STD-2500A, NITF, Version 2.0 for the NITFS.

Recommendations: ANSI/US PRO/IPO 100-1996 (Formerly IGES) is Year 2000 compliant and is recommended except for cases where STEP provides additional capabilities that are lacking in IGES and are critical to the accomplishment of the system. STEP includes IGES's functionality, but is more comprehensive. The CALS IGES specification, MIL-PRF-28000, specifies 4 classes of IGES files: Technical Illustration (I), Engineering (II), Numerical Control Manufacturing (IV), and 3D Piping (V). The CALS specification Class III, Electrical/Electronic, should not be used. For Electrical/Electronics IGES data, ANSI US PRO/IPO 100 Layered Electrical Product Application Protocol should be cited.

IGES products are implemented widely and are likely to be proposed by vendors whether or not a procurement specifies it. In contrast, STEP products must be specified explicitly. If STEP is specified in a procurement, then it should conform to the requirements in the ISO 10303 STEP.

8.3.3.2.4 Atmospheric Data Interchange

The following formats established by the World Meteorological Organization (WMO) Commission for Basic Systems (CBS) for meteorological data and published under the Manual for Codes, Volume 1, Part B, Binary Codes, WMO No. 306.

Best Practices

Not provided at this time.

Recommended Implementation

	Current ITSG	Projected ITSG			
Not Recommended	**1999**	**2000**	**2001/2002**	**2003/2004**	**Emerging**
	FM 92-X-GRIB FM 94-X-BUFR DEF	FM 92-X-GRIB FM 94-X-BUFR DEF	FM 92-X-GRIB FM 94-X-BUFR DEF	FM 92-X-GRIB FM 94-X-BUFR DEF	
Activities, Platforms, Operational Environments		Developers & Engineers			

Table 8-12. Atmospheric Data Interchange Standards

- FM 92-X-GRIB - The WMO Format for the Storage of Weather Product Information and the Exchange of Weather Product Messages in Gridded Binary (GRIB) Form. GRIB was developed for the transfer of gridded data fields (including spectral model coefficients) and of satellite images. A GRIB record (message) contains values at grid points of an array, or a set of spectral coefficients, for a parameter at a single level or layer as a continuous bit stream. It is an efficient vehicle for transmitting large volumes of gridded data to automated centers over high speed telecommunication lines using modern protocols. It can equally well serve as a data storage format. While GRIB can use predefined grids, provisions have been made for a grid to be defined within the message.
- FM 94-X-BUFR - The WMO Binary Universal Format for Representation (BUFR) of meteorological data. Besides being used for the transfer of data, BUFR is used as an on-line storage format and as a data archiving format. A BUFR record (message) containing observational data of any sort also contains a complete description of what those data are: the description includes identifying the parameter in question, (height, temperature, pressure, latitude, date, and time), the units, any decimal scaling that may have been employed to change the precision from that of the original units, data compression that may have been applied for efficiency, and the number of binary bits used to contain the numeric value of the observation. BUFR is a purely binary or bit oriented form.
- Data Exchange Format (DEF) - Appendix 30 to the Tactical Automated Weather Distribution System (TAWDS)/Integrated Meteorological System (IMETS) Implementation Document for Communication Information Data Exchange (CIDE).

8.3.3.2.5 Oceanographic Data Interchange

Standard transfer formats are required for the pre-distribution of oceanographic information. WMO GRIB and the BUFR file transfer formats are used for this purpose. The GRIB and BUFR extensions include several extensions, including provisions for additional variables, additional originating models, a standard method to encode tables and line data; a method to encode grids (tables) with an array of data at each grid point (table entry); and a method to encode multiple levels in one GRIB message. There is also a possible need to incorporate a method for vector product data.

Best Practices

None provided at this time.

Recommended Implementation

	Current ITSG	Projected ITSG			
Not Recommended	**1999**	**2000**	**2001/2002**	**2003/2004**	**Emerging**
	FM 94-X-BUFR	FM 94-X-BUFR	FM 94-X-BUFR	FM 94-X-BUFR	
Activities, Platforms, Operational Environments		Developers & Engineers			

Table 8-13. Oceanographic Data Interchange Standards

- FM 94-X-BUFR - The WMO Binary Universal Format for Representation (BUFR) of oceanographic data is appropriate for discrete oceanographic observations at a location, but it is inappropriate for gridded fields produced as a result of a model run, such as wave heights, sea surface, temperature, etc., In those cases the same formats used for Atmospheric Data Interchange FM 92-X-GRIB should be used.

8.3.4 Messages

8.3.4.1 Bit-Oriented Message Standards

The J-series family of Tactical Data Link (TDL) allows information exchange using common data element structures and message formats to support time critical information. Users include Air Operations/Defense, Maritime, Fire Support, and Maneuver Operations. The J-series family consists of Link 16, Link 22, and the Variable Message Format. Interoperability is achieved through the common use of the J-series family of messages and data elements. The policy and management of this family is described in the Joint Tactical Data Link Management Plan (JTDLMP), dated April 1996.

Best Practices

DON users shall address new message requirements using these messages and data elements or use the message construction hierarchy described in the JTDLMP.

Recommended Implementation

The JTIDS/TADIL J/Link 16 standards listed below are hierarchical in nature, and the relationships of these separate standards are explained in Operational Specification (OS) 516.2. The governing document for DON implementation of TADIL J message formats is OPSPEC 516.2. OPSPEC 516.2 references sections of MIL-STD-6016 for system implementations but adds more stringent requirements and formats. OS-516.2 references sections of MIL-STD-6016 for system implementations. Link 11/TADIL A will be subsumed into Link 16 and implementations of Link 16 are required to be interoperable with Link 11/TADIL A message standards.

Baseline	MIL-STD-6011A DoD Interface Standard Tactical Digital Interface Link (TADIL) A Message Standard, 24 January 1997 Navy Tactical Data Systems Model 4, Link 11 Operational Specification OS-411.3, Revision 3, 20 February 1997 MIL-STD-6004 DoD Interface Standard Tactical Digital Interface Link (TADIL) C Operational Interface Standard Navy Tactical Data Systems Link 4 Operational Specification OS-404.1 with Change 5, 20 December 1988 Includes JTIDS/TADIL J/Link 16 target standards
Target	JTIDS Technical Interface Design Plan - Test Edition (TIDP-TE), Reissue 3 August 1994 MIL-STD-6016 DoD Interface Standard Tactical Digital Interface Link (TADIL) J Message Standard, 7 February 1997 LINK 16 Operational Specification OS-516.2 Revision 2, 20 February 1997 STANAG 5516, Edition 1, Tactical Data Exchange - LINK 16, Ratified 2 March 1990 VMF Technical Interface Design Plan, - Test Edition (TIDP-TE), Reissue 1 February 1995
Emerging	STANAG 5516, Edition 2, is currently under development at JIEO for delivery to the NATO Data Link Working Group (DLWG). STANAG 5552, Edition 1, Tactical Data Exchange - LINK 22 (Undated) is the Configuration Management baseline document. VMF Technical Interface Design Plan - Reissue 2, is currently undergoing development at JIEO.

Table 8-14. Bit-Oriented Message Standards

JTIDS will soon be supplemented by the Multi-functional Information Distribution System (MIDS). Message format standards for MIDS will not change from those of the JTIDS. Message and data element standards must be independent of the information transfer standards, protocols, and profiles. Refer to Chapter 5 of this document for information transfer standards.

STANAG 5516, Edition 2, is currently under development at the DISA Joint Integration and Engineering Office (JIEO) for delivery to the NATO Data Link Working Group (DLWG).

STANAG 5552, Edition 1, Tactical Data Exchange - LINK 22 (Undated) is the Configuration Management baseline document.

8.3.4.2 Character-Oriented Message Standards

United States Message Text Format (USMTF) messages are jointly agreed, fixed-format, character-oriented messages that are man-readable and machine-processable. USMTF is the mandatory standard for record messages when communicating with the Joint Staff, combatant commands, and service components. The OS-OTG is in the process of being subsumed within the Variable Message Format (VMF) standard.

Baseline	Includes target Standard Operational Specification For Over-the-Horizon Targeting Gold (OS-OTG), Revision C - 1 August 1997 (Change 1 Scheduled Oct 98)
Target	MIL-STD-6040, United States Message Text Format (USMTF)

Table 8-15. Character-Oriented Message Standards

8.4 Database Management

This section provides the DON information management approach for life-cycle data management. Topics discussed include the following:

- Database Management Process
- Database Interoperability
- Database Documentation
- Database Management Systems

8.4.1 Database Management Process

The DON approach for achieving and maintaining database interoperability is to focus existing resources to:

- Identify and integrate user and system data requirements
- Register existing system data elements to use applicable standards
- Institute and manage DON approved data standards; recommend to DoD for approval as DoD data standards
- Implement approved standards in all systems
- Provide consistent, authoritative reference data
- Document and report information problems and solutions

The five interrelated sub-processes shown in Figure 8-7 provide a life cycle approach for database management across the DON enterprise.

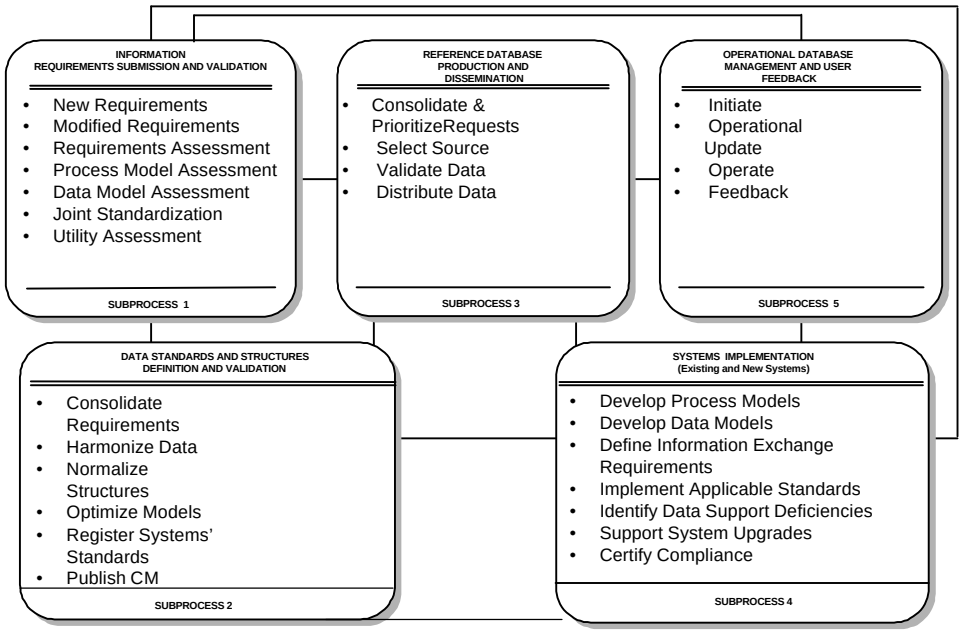

Figure 8-7. Development Approach

Coordinated implementation of these sub-processes provides effective and efficient life-cycle data management. It also enables the DON enterprise to gain better utility of existing resources and an increased return on IT investment. Each of the sub-processes is explained in the following paragraphs.

8.4.1.1 Information Requirements Submission and Validation

Provides the method by which validated operational requirements for information (both for new and existing systems) are established.

Fleet inputs are consolidated by the Fleet CINCs reflecting mission requirements that must be supported by new, emerging, and migration systems. These are brought together and validated by the resource sponsors. This subprocess establishes information collection priorities, identifies potential authoritative sources, optimizes resources, and obtains commitment to development and maintenance of new information standards.

8.4.1.2 Data Standards and Structures Definition and Validation

Provides the method to consolidate system information requirements into "essential elements of information" optimized for tactical Naval warfare and support infrastructure.

The data standards determine how data elements are named, defined, and managed. Registration of system data elements is a foundation for data standardization, database integration, and database synchronization.

8.4.1.3 Reference Database Production and Dissemination

Provides the method by which functional information managers produce and disseminate reference data.

This addresses what source is authoritative, who should produce the data, how data structures are defined, and how data is distributed. The data element fill or content varies according to the dataset to which the elements are assigned and the area of operations. Using validated data from authoritative national, service or theater producers will fill data elements for datasets that are common to all users. The data elements that define dynamic situations, such as target tracking, will be filled at the appropriate operating level.

Since several levels and categories of classified data are available, data security is vital. Access control policies and accountability requirements for the data are the responsibility of the respective producers.

8.4.1.4 Systems Implementation

Provides the method to implement approved information standards in legacy and migration systems.

To ensure intersystem information interoperability, system developers will comply with data and interface standards. Management of existing systems that are undergoing modernization should include a transition plan to DoD and DON data standards.

Program Managers will direct their Component Software Support Centers and Software Support Activities (SSC/SSAs) to work with the DON Data Administrator in registering their data element formats in the Defense Data Dictionary System (DDDS). Baseline DON and DoD standards will be derived from those elements that are registered. This will simultaneously provide unambiguous interface definitions for other systems (i.e., those systems that need to exchange data) to ensure optimal data flow. A Functional Information Manager (FIM) will be assigned to oversee the establishment and maintenance of a quality data base.

8.4.1.5 Operational Database Management and User Feedback

Provides the method by which operational users manage changes to reference data, how they supplement with specific or local data, and how they provide feedback on the validity and utility of data.

Data fill will not be completed for all data elements that are provided by the operational commanders. The DON process will be to register requests for data fill requirements and provide feedback on those requests. The goal is to complete those data fill requests that reflect optimal use of production assets in support of operational needs.

Once the common reference database is distributed by the FIM, battle group and local data is added to optimize operational databases. The operational databases are a combination of the basic loads tailored with regional and local fill. Figure 8-8 provides a methodology for documenting and reporting information management problems and solutions.

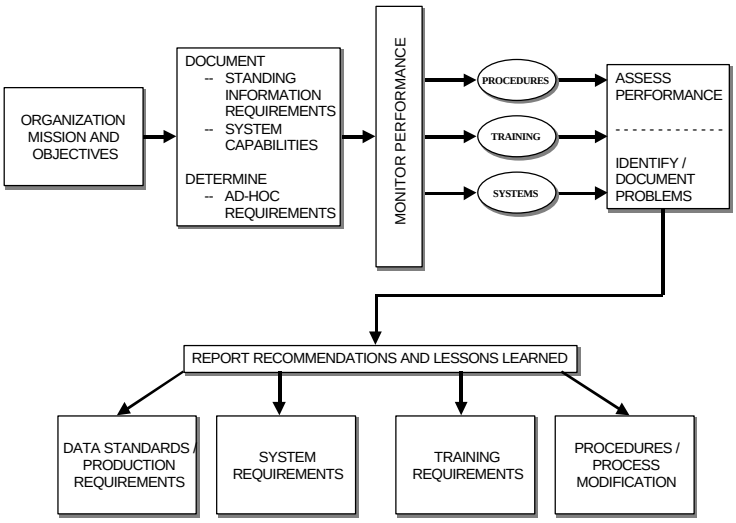

Figure 8-8. Information Improvement Process

Recommended Implementation

	Current ITSG	Projected ITSG			
Not Recommended	**1999**	**2000**	**2001/2002**	**2003/2004**	**Emerging**
	DoDD 8000.1 DoDD 8120.1 DoDD 8320.1 DoDD 4630.5 Review OPNAVINST 9410.5 Review OPNAVINST 9410.6 Review MCO 3093.1 Review NAVINTCOMINST 3890.1 Review OPNAVINST 3430.23 Review OPNAVINST 3140.54 Review OPNAVINST 3140.55	Implementation Plans*			
Activities, Platforms, Operational Environments		Information Producers and Data Base Developers			

Table 8-16. DON Information Management Implementation

* Implementation Plans – the SYSCOMs, PEOs, SEOs and PMs should ensure that implementation plan(s) support directives and instructions dealing with data acquisition, information management, data administration, and information interoperability.

8.4.2 Database Interoperability

Understandable descriptions of the database are key to data interoperability. Figure 8-9 provides an overview for defining and harmonizing the DON data environment. These products provide the enterprise baseline for registration in the DDDS.

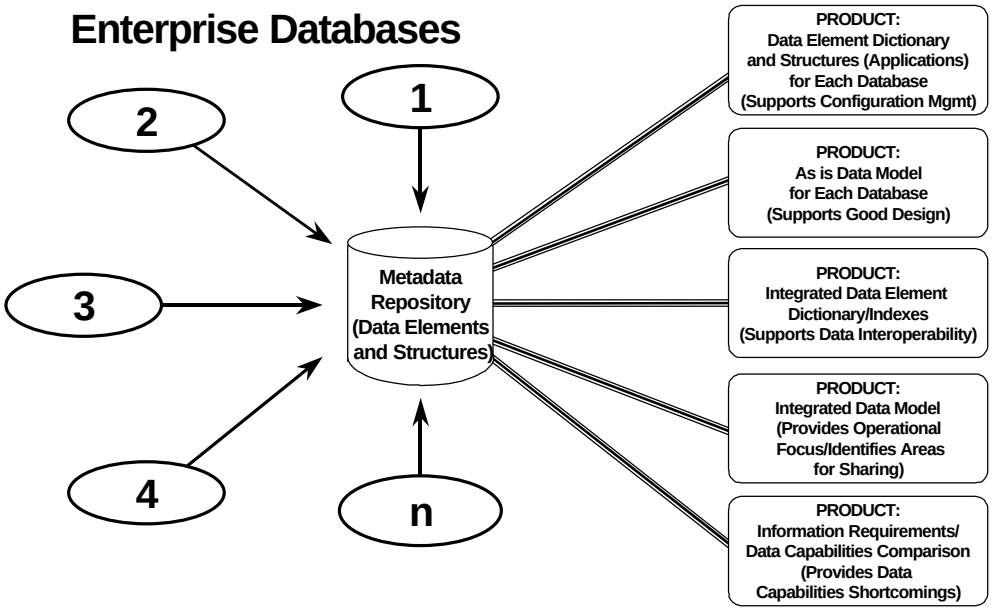

Figure 8-9. Methodology for Achieving and Maintaining DON Information Interoperability

8.4.2.1 Establishing and Maintaining a Baseline (Registration)

Figure 8-10 provides a methodology for capturing knowledge in order to assess the impact or goodness of proposed DoD data standards. Establishing a baseline requires a consistent process by which to organize data elements, define attributes, and select data sources.

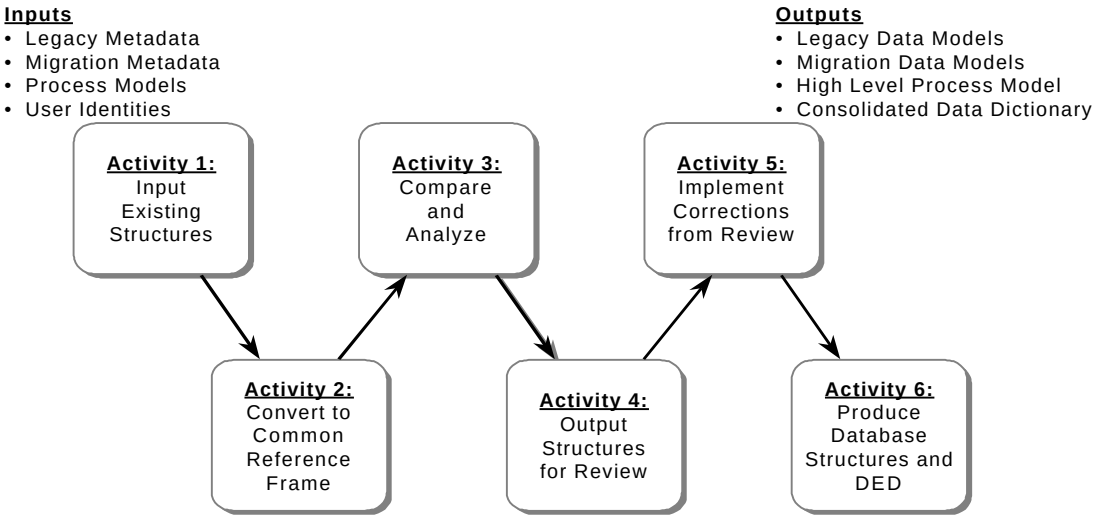

Figure 8-10. Capturing Metadata in a Common Format

8.4.2.1.1 Organizing Data Elements

Database structures are used to organize data elements to support applications. Figure 8-11 illustrates how data elements are grouped to define an area of interest. The example shows a grouping that defines the cargo of a merchant ship.

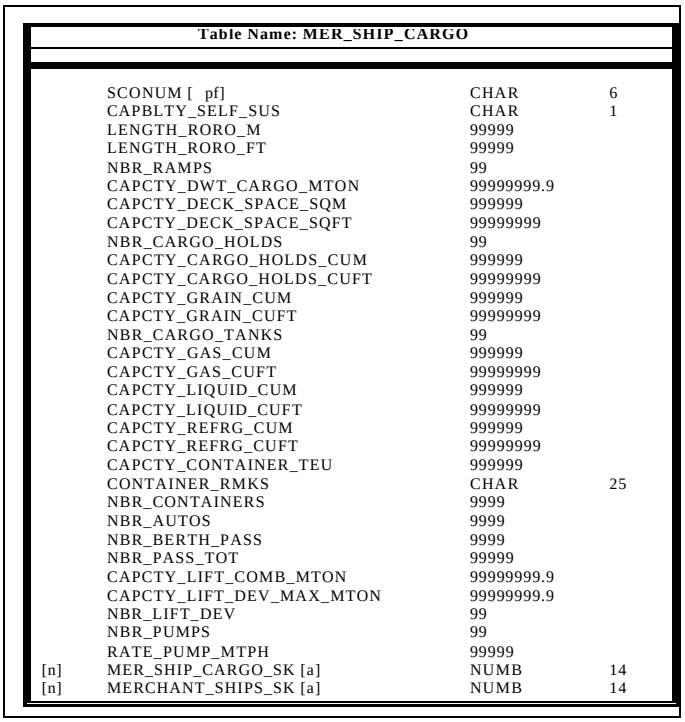

Table Name: MER_SHIP_CARGO

	SCONUM [pf]	CHAR	6
	CAPBLTY_SELF_SUS	CHAR	1
	LENGTH_RORO_M	99999	
	LENGTH_RORO_FT	99999	
	NBR_RAMPS	99	
	CAPCTY_DWT_CARGO_MTON	99999999.9	
	CAPCTY_DECK_SPACE_SQM	999999	
	CAPCTY_DECK_SPACE_SQFT	99999999	
	NBR_CARGO_HOLDS	99	
	CAPCTY_CARGO_HOLDS_CUM	999999	
	CAPCTY_CARGO_HOLDS_CUFT	99999999	
	CAPCTY_GRAIN_CUM	999999	
	CAPCTY_GRAIN_CUFT	99999999	
	NBR_CARGO_TANKS	99	
	CAPCTY_GAS_CUM	999999	
	CAPCTY_GAS_CUFT	99999999	
	CAPCTY_LIQUID_CUM	999999	
	CAPCTY_LIQUID_CUFT	99999999	
	CAPCTY_REFRG_CUM	999999	
	CAPCTY_REFRG_CUFT	99999999	
	CAPCTY_CONTAINER_TEU	999999	
	CONTAINER_RMKS	CHAR	25
	NBR_CONTAINERS	9999	
	NBR_AUTOS	9999	
	NBR_BERTH_PASS	9999	
	NBR_PASS_TOT	99999	
	CAPCTY_LIFT_COMB_MTON	99999999.9	
	CAPCTY_LIFT_DEV_MAX_MTON	99999999.9	
	NBR_LIFT_DEV	99	
	NBR_PUMPS	99	
	RATE_PUMP_MTPH	99999	
[n]	MER_SHIP_CARGO_SK [a]	NUMB	14
[n]	MERCHANT_SHIPS_SK [a]	NUMB	14

Figure 8-11. Data Element Table

8.4.2.1.2 Defining Data Attributes

Data elements must be defined to reflect functional context. Figure 8-12 provides an example of some of the attributes used to define a data element.

Access Name: SCONUM
Long Name: SHIP CONTROL NUMBER
Definition: The ship control number assigned to a ship by the Navy Operational Intelligence Center (NAVOPINTCEN) for record identification purposes.
Type: VARCHAR2 **Length :** 6
Unit of Measure:
Domain Low :
Domain Value Identifier(s) and Definition(s):
Database: NID V3
Table Usage : MERCHANT_SHIPS,
MER_SHIP_ALT_NAMES,
MER_SHIP_ANTENNA,
MER_SHIP_CARGO,

Figure 8-12. Data Element Description

8.4.2.1.3 Functional Information Managers

To implement data administration it is necessary to identify DON Functional Information Managers (FIM) to assist in developing procedures for both inter-and intra-functional data standardization and the broader goal of information interoperability.

8.4.2.1.4 Authoritative Data Sources

Functional Information Managers should establish close working relationships with authoritative data sources for their respective reference data, e.g. C3, intelligence, logistics, personnel, medical, and acquisition.

8.4.2.1.5 Data Repositories

A data repository contains the metadata (data about data) associated with an enterprise or functional area. The Defense Data Dictionary System (DDDS), operated and maintained by DISA, contains the DoD archived, developmental, candidate disapproved and approved DoD data standards. The Secure Intelligence Data Repository (SIDR), sponsored by the Defense Intelligence Agency and the National Security Agency (NSA), is under development to maintain classified standard and candidate standard DoD data elements.

8.4.2.2 Achieving Information Interoperability

Four important efforts that will lead to information interoperability are the following:

- Definition and implementation of database segments
- Data element standardization as part of migration database integration
- Database synchronization
- Data warehousing and mining

8.4.2.2.1 Definition and Implementation of DII COE Database Segments

DON is supporting the development of DII COE database segments. One such effort is JMCIS. Software modules are being submitted to the DISA Shared Data Environment (SHADE) for run time compliance testing. As segments are produced, their associated data will have to be normalized and synchronized.

8.4.2.2.2 Data Element Standardization as part of Migration Database Engineering

Individual system databases should be normalized to reach the state of one fact, one place. Databases within a functional area should be harmonized to provide data quality and efficiency of life cycle data maintenance. Figure 8-13 illustrates how legacy databases can be mapped to migration databases to ensure information requirements continue to be satisfied by new systems. Mapping and matching of non-standard data to DoD standards will be done per DoD 8320.1-M-1.

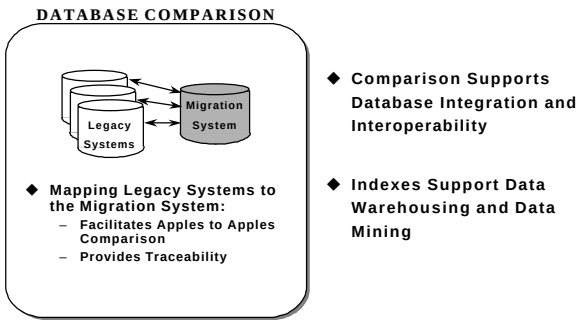

Figure 8-13. Data Element Comparison and Linking

8.4.2.2.3 Database Synchronization

Database synchronization can be achieved by mapping the data elements and aggregating the databases into a single model. Figure 8-14 shows a telecommunications links and nodes model that was developed as part of an information warfare data standardization study involving multiple databases. Each of the different databases reflects their command's view of their mission and organization. Aggregation of the separate views into an integrated view provides a framework for sharing and interoperability.

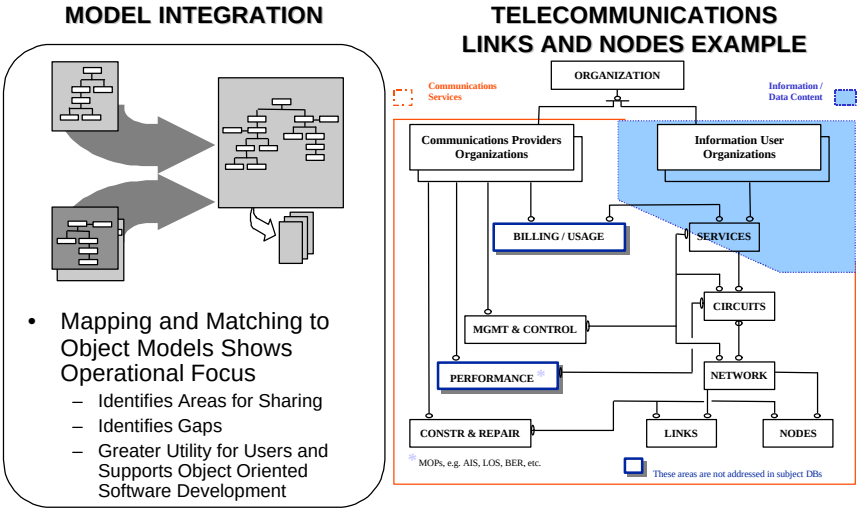

Figure 8-14. Database Synchronization

8.4.2.2.4 Data Warehousing and Mining

Data warehousing and mining strategies will be facilitated by database normalization, functional harmonization, and cross-functional synchronization. A data warehouse is an informational database implementation used to store sharable data sourced from operational databases-of-record. It is typically a subject database that allows users to tap into an operational or functional command's vast store of operational data to gain access to data/information.

Data mining is a technique using software tools geared to the user who typically does not know the specific data they are searching for, but are looking for particular data patterns or trends. Data mining is the process of sifting through large amounts of data to produce data content relationships.

8.4.3 Database Documentation

Documentation of systems databases in a common format provides a basis for functional process improvement and cross-functional sharing. Documentation provides a context for developing data metrics. There are commercial and government off-the-shelf tools to provide a means to capture the data to support information management and information engineering.

Best Practices

DON information management policy will be implemented through the DON CIO for all warfare and warfare support communities. DON systems managers will produce and maintain data

element dictionaries and data structures in approved DoD format. Copies will be provided to the DON Component Data Administrator for coordination with DoD components.

Recommended Implementation

	Current ITSG	Projected ITSG			
Not Recommended	**1999**	**2000**	**2001/2002**	**2003/2004**	**Emerging**
	DII/COE TAFIM/JTA DoDD 4630.5 DOSI 4630.8 DoDD 8120.1 DoDD 8320.1 FIPS 183 FIPS 184	Implementation Plans			
Activities, Platforms, Operational Environments		Data Base Developers			

Table 8-17. DON Data Base Documentation Guidance

Note

Implementation Plans – the SYSCOMs, PEOs, SEO's and PMs should ensure that implementation plan(s) support directives and instructions dealing with data acquisition, information management, data administration, and information interoperability.

8.4.4 Database Management Systems

Data management services give applications access to structured data in a distributed environment. The ISO Structured Query Language (SQL) standard is the primary interface to relational databases, but the SQL Access standard extends this interface to access databases over a network.

Database technology is evolving rapidly. Data storage and access have matured from simple flat files into sophisticated database management systems (DBMS) based on hierarchical, networking, relational, and multidimensional data models. Object-oriented technology bases the object management system on the object model. Databases continue to grow exponentially in size, from hundreds of gigabits to multi-terabyte.

Current and future trends for databases focus on DBMSs based on the relational model and the object model or a hybrid of the two. The hybrid DBMS may extend the relational model to support aspects of the object model, such as complex data types (voice and image) or encapsulation (the packaging of an object's data and processes). Conversely, the hybrid DBMS may extend the object model to support aspects of the relational model, such as SQL.

The various Relational Database Management Systems (RDBMS) vendors are currently examining the capability to construct multidimensional “cubes” as a strategic base function to add to RDBMS database engines. Increased market demand for decision support systems (DSSs) and the complex data analysis inherent in DSS has provided the momentum for adding this capability.

The Internet/intranet has increased the need for DBMSs to support more complex data types, such as audio and video. In fact, DBMS vendors are interested in providing Web server capabilities within their databases, relieving the need to have both a web server and a database server.

Each data model provides benefits that are specific to business needs. For example, DSSs may be best served by DBMSs based on the relational or multi-dimensional models. Support for complex data types, such as full motion video, may be better suited for DBMSs based on the object model. Guidelines for selecting a DBMS model are based on the type of data and its relationships (Figure 8-15).

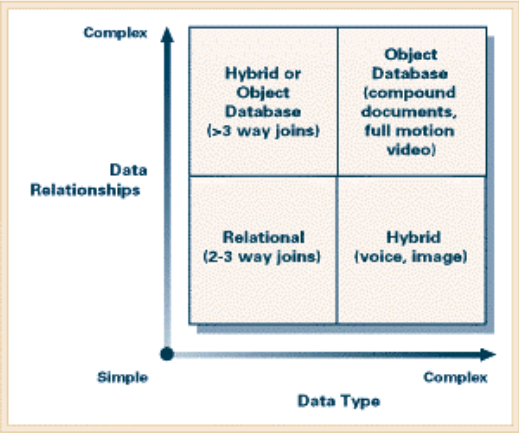

Figure 8-15. Guidelines for Selecting a DBMS Model

In today’s business environment, data is typically spread across multiple DBMSs, hardware, and operating system platforms. Access to an enterprise’s data can be complex. Two areas that have addressed this complexity are standards and middleware.

8.4.4.1 Relational Database Management Systems (RDBMSs)

Several RDBMSs provide Client /Server products and support for some aspects of the object model. The Open Group (TOG), through its XA specification, defines a standard interface between RDBMSs and transaction processing systems. TOG’s specification, based closely on the ISO standard for SQL, provides a common SQL for data access and manipulation. The Remote Data Access (RDA) specification defines the formats and protocols required for an SQL application to communicate with a remote database (Figure 8-16).

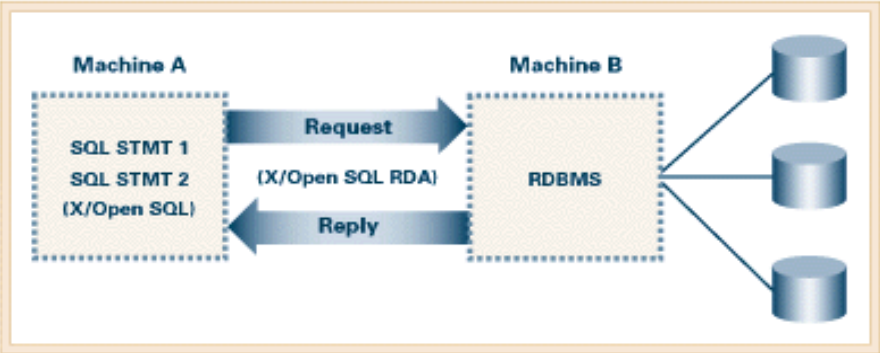

Figure 8-16. The Open Group SQL and RDA

Interoperability between relational databases became a problem when multiple RDBMSs were introduced in the market. The Open Group and the SQL Access Group (SAG) made progress toward RDBMS interoperability when they jointly published two key specifications: the SQL RDA specification and an updated version of SQL. This update combined the efforts of SAG and TOG to provide a unified standard.

Best Practices

In accordance with FIPS Pub 127-2:1993, Database Language for relational DBMSs, select a RDBMS that supports both the entry level SQL standards and The Open Group's XA standards. The API recommended for both database application clients and database servers is the Open Data Base Connectivity, ODBC 2.0.

Recommended Implementations

	Current ITSG	Projected ITSG			
Not Recommended	**1999**	**2000**	**2001/2002**	**2003/2004**	**Emerging**
	ISO SQL ISO RDA TOG SQL TOG RDA TOG XA TOG SQL CLI DB2 ODBC 2.0	ISO SQL ISO RDA TOG SQL TOG RDA TOG XA TOG SQL CLI DB2 ODBC 2.0	ISO SQL ISO RDA TOG SQL TOG RDA TOG XA TOG SQL CLI DB2 ODBC 2.0	ISO SQL ISO RDA TOG SQL TOG RDA TOG XA TOG SQL CLI ODBC 2.0	
Activities, Platforms, Operational Environments		Data Base Developers			

Table 8-18. Relational Database Management Systems

TOG's RDA and IBM's Distributed Relational Database Architecture (DRDA) offer a different approach to Client /Server database interoperability. Through DRDA, IBM provides interoperability among its relational database managers found on its different hardware and operating system platforms. DRDA does not focus on general industry-wide interoperability and, therefore, is not recommended.

8.4.4.2 Object-Oriented Database Management Systems

Object-oriented database management systems (OODBMSs) are used primarily for small to medium systems that require extensive use of nontraditional data types used in engineering (computer-aided design/computer-aided manufacturing [CAD/CAM]), manufacturing (CIM), geographic information systems, and, more recently, Internet/intranet multimedia applications. Although several standards organizations are working on standards for object management for databases, these standards lag behind RDBMS standards.

The Object Data Management Group (ODMG) is a consortium of vendors and interested parties who collaborate to develop and promote standards for object storage. The current standard published by the consortium is ODMG Release 2.0. Its purpose is to ensure the portability of applications across different DBMSs. ODMG is built upon existing standards wherever possible. The ODMG specification is a set of components that include an Object Model, an Object Definition Language, an Object Query Language, and Language Bindings to Java, C++, Smalltalk.

Best Practices

Select products that comply with ODMG 2.0. Alternatively, minimize risk by selecting an OODBMS supplier that participates in, or supports, the following standards organizations: ODMG, Object Management Group (OMG), and the ANSI X3 subgroup, Object-Oriented Database Task Group.

Recommended Implementations

	Current ITSG	Projected ITSG			
Not Recommended	**1999**	**2000**	**2001/2002**	**2003/2004**	**Emerging**
	ODMG 2.0	ODMG 2.0	ODMG 2.0	ODMG 2.0	SQL3
Activities, Platforms, Operational Environments		Data Base Developers			

Table 8-19. Object-oriented database management systems

8.4.4.3 Database Access

Database access middleware, also referred to as database gateway middleware, resides between the client application and the supplier DBMS or file system. Database access middleware provides the client application and end user with a single method and view of accessing data in a heterogeneous database environment. The method can vary from APIs to fourth-generation languages (4GLs) or to gateways (point-to-point, SQL, or universal).

Standard APIs are preferred for applications because APIs are more portable and interoperable. 4GLs and gateways are well suited for end-user access to heterogeneous databases. Point-to-point and SQL gateways tend to support limited databases, but universal gateways support various DBMSs and file systems.

Sun Microsystems' Java language specification for developing Internet/intranet applications has provided impetus for the development of the Java Database Connectivity (JDBC) API. This API provides a standard SQL database access interface from a Java application. These JDBC drivers can be categorized as:

- JDBC- open database connectivity (ODBC) bridge – provides JDBC access via most ODBC drivers. Some ODBC binary code and, in many cases, database client code must be loaded on each client machine that uses this driver.
- Native-API, partly Java driver – converts JDBC calls into calls on the client API for Oracle, Sybase, Informix, DB2, and other DBMSs. Like the bridge driver, this style of driver requires that some binary code be loaded on each client machine.
- Net protocol, all-Java driver – translates JDBC calls into a DBMS-independent net protocol, which is then translated into a DBMS protocol by a server. This net server middleware can connect all its Java clients to many different databases. The specific protocol used depends on the vendor. In general, this JDBC alternative is the most flexible.
- Native-protocol, all-Java driver – directly converts JDBC calls into the network protocol used by DBMSs, thus allowing a direct call from the client machine to the DBMS server. Since many of these protocols are proprietary, the database vendors themselves will be the primary source for this style of driver.

Best Practices

For applications (developed or purchased), use standards-based APIs for database access. When choosing end-user database middleware, consider products that support an SQL or universal gateway.

Recommended Implementations

	Current ITSG	Projected ITSG			
Not Recommended	**1999**	**2000**	**2001/2002**	**2003/2004**	**Emerging**
Point-to-point gateways APPC-only gateways	ISO RDA TOG RDA TOG SQL CU	ISO RDA TOG RDA TOG SQL CU	ISO RDA TOG RDA TOG SQL CU	ISO RDA TOG RDA TOG SQL CU	JBDC
Activities, Platforms, Operational Environments		Data Base Developers			

Table 8-20. Database access

- Microsoft's ODBC and Borland's Integrated Database API (IDAPI) are based on TOG SQL Call Level Interface (CLI).

8.4.4.4 Document Management System

8.4.4.4.1 Business, Administrative, Management Documents

Document-based data, such as word processing files, spreadsheets, photographs, microfilm, microfiche, and existing paper media represent a majority of information required to be processed, maintained, and updated by Government agencies and commercial firms. Traditional hard copy methods of document management generally include some type of filing system with hard copy or electronic indexes to facilitate retrieval of the documents. Electronic document management systems emulate the hard copy paradigms, however, many advantages can be derived, using the power of computing technology. These advantages include quick search and retrieval of documents, easy manipulation of data, rapid dissemination and routing of documents, saving of storage space, etc. With all the advantages of electronic handling of information, comes the challenge of version control. A good electronic document management system will combine the advantages that computer technology gives us with the capability to control revisions. Specifically, a document management system should include the following basic capabilities:

- Data Capture. A document management system must have the capability to capture data, either paper-based information, native electronic (e.g. Microsoft Word files), audio/video formats etc. for inclusion into the system. This data capture should also include, where possible, non-standard file formats (e.g. Adobe Acrobat).
- Data Distribution. All data within the management system should have the capability to be distributed via local/wide area networks.
- Document Manipulation. Users must have the capability to index and categorize documents, track document access/retrieval to automate business practices.
- Data Access. Rights to information with the document management system must be assigned for individual/groups of users to ensure appropriate access is granted.
- Data Retrieval. There should be the capability to deliver documents to the desktop for display, review, annotation, revision, printing, copying, faxing, e-mailing etc.
- Data Storage. A document management system should have the capability to store data both on-line, near-line, and off-site for disaster recovery purposes. Storage media should include CD-ROM, hard dives (e.g. RAID), optical disks, magnetic tape etc. as available options.
- Document Interaction with Third Party Software. To the greatest extent possible, document management systems should allow the use of third party software for extraction of data in its native format.
- Data Revision Control. All revisions to a document should be distinguished from one another. It may also be controlled through data access rights by a central group or administrator.
- Work Flow. Document management should include workflow (the capability to manage/route/create documents electronically). Significant work flow features include:
    - Information Assembly. A variety of data types can be supported.
    - Work Routing. Work routing defines the order in which the items flow.
    - Workflow Map. Work may be routed graphically without third party programming.
    - Tracking. Once implemented, the status of all transactions can be checked.

8.4.4.4.2 Technical Manuals

Navy technical manuals (TMs) and related technical text documents and training manuals concerned with weapon system and platform logistics and life cycle support require additional document management considerations. These documents will be delivered, maintained, and managed in Standard Generalized Markup Language (SGML) format in compliance with MIL-PRF-28001. TM document management systems must maintain and track many TM versions supporting corrections, engineering change revisions, and various product configurations. The document management system must support the basic capabilities outlined above for business documents, authoring and revision in an SGML environment, and document version and revision control. These management systems must address documents at a level lower than files or documents, it must support document tagging at the component level for effective product configuration management. In addition to these capabilities listed in Sec 8.4.4.4.1, TM document management systems must have the following additional capabilities:

- Collaborative Authoring and Editing. Allows one author to edit a part of a document while others edit other parts of the document.
- SGML compliant. Supports and manages SGML documents.
- Data Reuse. Allows data to be copied or shared among documents.
- Data Query. Enables data search.
- Component level management. Manages and controls edits, revisions and versioning at the document level and the SGML element/component level.
- Component version management. Manages, tracks, and indexes revision/version levels at document component (SGML element) level.
- Eliminate data redundancy. Stores, retains, and manages only one copy of document elements that appear in multiple versions of the document. This is required so that a single edit action is reflected in all versions.

Best Practices

Employ commercially available document management systems that are ODBC compliant, accept a wide variety of file formats, and allow graphical work flow routing without requiring a third party programmer. For technical manuals, the document management system must support SGML element level versioning and document management.

Guidance

Choose a document management system that will provide the following features:

- COTS available
- Visual work flow programming
- Object Oriented
- OCR/Fax/E-mail/COLD Capable
- Use CCITT GroupIV Compression Methods
- Electronic Import/Export Utility
- Interface with Third Party Programs
- Support both structured/ad hoc work flow

- OLE Compliant
- Easy to Use
- ODBC Compliant
- Network Secure
- Annotation of Data (e.g. redlines etc.)
- Multiple Output Formats (e.g. CD-ROM etc.)

For Technical Manuals:

MIL-PRF-28001 (SGML)

8.5 Data Quality and Interoperability Metrics

Chapter 10 discusses Information Quality. This section addresses measuring quality of the data from which information is derived. It defines the relationship of data metrics to information quality, describes related efforts, and identifies a process for defining a viable data metrics effort and related automated tools as part of an overall information evaluation effort.

8.5.1 Data Quality versus Information Quality

While information quality and data quality are obviously related, there are significant differences in how they are defined, measured, and achieved. Data is distinguishable from the software and refers to the information building blocks inside the computer; the data quality refers to the quality of the data within the computer databases. Information quality is the external quality that relates to the utility of computer outputs.

Drawing distinctions between software and data is difficult in database applications where data can be mistaken for a special form of software and subject to software metrics and solutions. The principal distinction is that data represents discrete pieces of raw material in the form of specially formatted real-world facts while software consists of computer program instructions for processing the data. If the raw material is incomplete, ambiguous, or otherwise flawed, then no amount of processing will produce valid information. If data is corrupt within a system, the data in a network of such systems will become geometrically more corrupt with the addition of each new source of bad data.

8.5.2 Data Interoperability

There is a requirement to develop data metrics to assess and support system data interoperability. This has been difficult because data structures are hidden in software applications and systems documentation is often inadequate or not in a common format to support analysis. As automated CASE tools are required for efficient systems development, automated performance tools are required to support data interoperability comparisons and assessments. Major database management system producers and third party vendors offer a wide range of database monitoring software with an array of metrics. For example, a major manufacturer has an integrated set of tools to measure hundreds of metrics and to provide database management performance. While these tools provide a means to measure individual database or network performance, there is still no comprehensive method of evaluating the structure and integrity of the information architecture and its data infrastructure.

The C4ISR Core Architecture Data Model (CADM), sponsored by OSD and JCS, provides a foundation for addressing the tactical information architecture. Registration of unclassified databases in the DDDS is accomplished through the Personal Computer Access Tool (PCAT). The Secure Intelligence Data Repository (SIDR) is the repository for classified databases. In addition, the Data Analysis and Reconciliation Tool (DART), produced under the aegis of the Naval Warfare Tactical Database (NWTDB), provides automated comparison of databases and message standards to assess interoperability. These tools are discussed in greater detail in Information Engineering Tools, Section 8.6.

8.5.3 Database Assessment Areas

Data is collected and stored in automated systems using a database schema. This schema may be a flat file (like a spreadsheet), a relational database or object-based system. Regardless of the schema, the areas for assessing the value of a database, and the value of the data within the database are the same. A list of questions to aid in assessment are as follows:

- Does the database contain the data required to support decision-makers at the level of their decision? This question addresses the aspects of accuracy, precision, currency, and completeness of the data. It also addresses the question of how much detail is needed for a decision at a given operational level. These quality issues are addressed in Chapter 10.
- Is there duplication within the database? Efficiency for a database means one fact in one place. Depending on the schema, replication of data within a database can either create the need for additional lines of code and hence additional costs, or cause the need for cross checking data updates to ensure all data elements are current. Such cross checking increases the costs of database maintenance. Duplication is addressed in Chapter 10.
- Is the data interoperable with other applications within a networked system? This question deals with both the format of the data and its domain. For example, data in a proprietary format may not be assessable by another application. In a similar manner, data with a domain value of degrees (true) will need a conversion for interoperability with an application that uses degrees (relative). In the first example, the data has no value to other applications regardless of its accuracy, precision, currency or completeness because it cannot be assessed. In the second example, there is a cost in converting the data to another domain value, and if the domain values are not understood to be different, then serious operational errors can occur.
- Is the data interoperable with other systems outside the network? This question not only addresses the format and domain value of a discrete data element, but also addresses the ability to tailor the data appearance from a very detailed to a less detailed view. For example, consider a radar frequency intercept by a system with accuracy to five decimal places vis-a-vis one that only stores frequencies to two decimal places. Inability to tailor the data to a useful view both for the consumer and for the automated system renders the data useless.

8.5.4 Selecting Performance Metrics

The services performed by the database could be listed as outcomes for each service request made of the system. Generally, these outcomes can be classified into three categories. The system can perform the service correctly, incorrectly, or refuse to perform the service. If the system performs the service correctly, its performance is measured by the time taken, the rate, and the resources consumed (responsiveness, productivity, and utilization metrics respectively). If the system performs the service incorrectly, an error is said to have occurred. It is helpful to classify errors and to determine the occurrences of each class of errors. If the system does not perform the

service, it is said to be down, failed, or unavailable. It is helpful to classify the failure modes and to determine the occurrences of each class.

Validity and reliability are the two most important criteria of measurement quality. Validity refers to whether the metric really measures what it is intended to measure. Reliability refers to the consistency of measurements of the metric and measurement method. Basic measures such as ratio, proportion, percentage, and rate all have specific purposes.

Desirable properties of metrics; they should:

- Be robust (that is, repeatable, precise, insensitive to minor changes)
- Suggest a norm
- Relate to specific processes, databases, or messages
- Suggest an improvement strategy
- Be a natural result of a process, database, or message (This is especially important for conserving resources when collecting metrics.)
- Be simple (and easy to explain)
- Be predictable and trackable (This allows predictions to be compared with actual experience.)

To assess interoperability of data, System Managers will document their databases in DoD approved format and produce and maintain a Data Element Dictionary and Database Structures (relationships).

The OSD developed tool to measure Levels of Systems Interoperability (LISI) should be used as guidance in determining interoperability. The LISI model is shown in Table 8-17. This tool tracks the compliance levels of the DII/COE and should be used as guidance in determining interoperability for system databases.

	Procedures	**Applications**	**Infrastructure**	**Data**
Enterprise	Enterprise Level	Interactive	Multiple Topologies	Enterprise Model
Domain	Domain Level	Groupware	World Wide Networks	Domain Model
Functional	Program Level	Desktop Automation	Local Networks	Program Model
Connected	Local/Site Level	Standard System Drivers	Simple Connection	Local
Isolated	Access Control	N/A	Independent	Private

Table 8-17. LISI Reference Model

The following describes the Data Architecture at each LISI Level:

- Enterprise (LISI Level 4) - Enterprise data models support the integration of applications. There is common understanding of the data across the enterprise.
- Domain (LISI Level 3) - Defined data models exist and are understood between applications, however, they only represent a particular domain.
- Functional (LISI Level 2) - Advanced data structures may exist but they still primarily support individual applications. Increasing commonality of data formats across programs.
- Connected (LISI Level 1) - Local data models exist, but are usually specific to a particular program.
- Isolated (LISI Level 0) - Private data models only.

Recommended Implementation

	Current ITSG	Projected ITSG			
Not Recommended	**1999**	**2000**	**2001/2002**	**2003/2004**	**Emerging**
	DII/COE TAFIM/JTA	Imp Plans			
Activities, Platforms, Operational Environments		Data Base Developers			

Table 8-21. Data Quality and Data Interoperability Perfromance Metrics Implementation

Note

Imp Plans – the SYSCOMs, PEOs, and PMs should ensure that implementation plan(s) support directives and instructions dealing with data acquisition, information management, data administration, and information interoperability.

8.6 Information Engineering Tools

Tasks associated with information engineering and data administration are supported by a variety of specialized software tools. Tools perform two essential functions. First, in automated or semi-automated form, they provide essential efficiencies required to implement integrated, interoperable systems and data for network centric warfare in joint and coalition warfare environments. Second, they serve to precisely define and enforce management policy across the broad spectrum of users in a network centric environment.

Most of the government or commercial information management tools currently available are designed to promote efficiencies within the confines of a specific organization, functional area, or methodology. Few tools cross these boundaries to link overlapping capabilities and requirements. Network centric warfare and concepts such as data mining and warehousing all require tools that support a highly integrated information environment. The broad scope required of such tools is being defined in the tactical community by initiatives such as the C4ISR Core Architecture Data Model (CADM).

While information management describes the general policy and priorities, information engineering is made up of methodologies that are predictably and scientifically implemented. Current information engineering tools are described by categories to illustrate their capabilities and relationships. The following categories of tools are discussed:

- Process Modeling Tools
- Data Modeling Tools
- Information Transfer Management Tools
- Architecture Management Tools

8.6.1 Process Modeling Tools

The standard for process modeling within the DoD is defined as the IDEF0 standard and is promulgated in Federal Information Processing Standards Publication, FIPS-183. Currently, the

most widely used commercial tool in the DoD that complies with this standard is BPwin by Logic Works, Inc. Future tools in this area should broaden their perspective and capture more specific process concepts as described in the DoD structures of the Universal Joint Task List (UJTL), service extensions to UJTL, and the C4ISR CADM. The Data Analysis and Reconciliation Tool (DART) is one the few tools which incorporates the UJTL and has a goal of incorporating components from the CADM.

8.6.2 Data Modeling Tools

A wide variety of government and commercial tools exist to support data modeling. The DoD standard for data modeling is defined as the IDEF1X standard and is promulgated in Federal Information Processing Standards Publication, FIPS-184. Among the most widely used commercial tools in the DoD that comply with this standard is ERwin by Logic Works, Inc.

- The Defense Data Dictionary System (DDDS) is the DoD core repository for defining standard and non-standard data elements. The Personal Computer Access Tool (PCAT) is a standalone, Microsoft Windows based implementation of the DDDS. While the DDDS and PCAT both focus at the data element dictionary level, they have plans to directly integrate with the IDEF1X standard in the future.
- In order to meet the requirements for managing classified data models the Secure Intelligence Data Repository (SIDR) is being developed for the intelligence community.
- The Comprehensive Utilities for Data Administration (CUDA) is a web based, client-server tool developed by the Naval Meteorology and Oceanographic Command (METOC). This tool complies with the data element standards of the DDDS and integrates this data dictionary with the IDEF1X ERwin tool. The CUDA includes capabilities for both model display in the web environment and collaborative groupware modeling.
- The DART complies with the DDDS data element registration standard, and it also integrates system modeling and extensive inter-system and information transfer standard comparison/analysis functions.

8.6.3 Information Transfer Management Tools

DoD information standards include USMTF, TADIL, and VMF along with their NATO equivalents. The integration transfer and database system standards have been a relatively recent initiative. The most prominent commercial tool is IRIS, European workstation grade tool. The most capable government tool is embodied in the Message Transfer Standard (MTF) extension to the DART. This tool examines and compares US/NATO MTF baselines both among themselves and with DART registered database systems.

8.6.4 Architecture Management Tools

Architecture management tools are those that must respond to the broad and dynamic environment of both network centric warfare and commercial enterprises such as data warehousing and data mining.

- A vision of the broad scope of such a DoD tool is suggested by developing architecture initiatives such as the C4ISR CADM. The CADM embodies and integrates many existing DoD and Services information architectures including the DoD Data Model, C2 Core Data Model, and the Navy's C4ISR Architecture Data Model.

- One of the few tools which has begun to capture this broad perspective is the DART, as part of the Naval Warfare Tactical Database (NWTDB) initiative. The DART has an integrated agenda that includes the registration of databases as real-world systems, information transfer standards registration, and DoD data dictionary standards.

These individual perspectives can then be subjected to individual and comparative analysis by automated and semi-automated processes. However, a fully capable architecture tool would have an even broader scope that would include rapid configuration management of information interoperability over a large community of users. Extended capabilities would need to examine and validate real-world operational data in addition to system descriptions.

8.6.5 GOTS Information Tool Descriptions

Comprehensive Utilities for Data Administrators (CUDA)

This application was developed to address the needs of Data Administrators not otherwise addressed by commercial or government supplied software products. The developers of the CUDA integrated and extended it from the existing suite of software to include some emerging technologies. The CUDA provides Data Administrators with a low-cost data model-based repository for prospective and approved data standards. The provided functions include:

- Batch loading of proposed standards from ERwin to the DDDS.
- Synchronization of ERwin with the data standards/metadata contained in the DDDS.
- Production of files to support the publication of data models on the World Wide Web (WWW).

Data Analysis and Reconciliation Tool (DART)

DART is a Microsoft Windows-based application that provides the following

- Database registration and reverse engineering (capturing existing database formats and structures)
- Data standardization (data element matching, mapping, and generation)
- Database configuration management and version control
- Database integration (migration system database engineering)

DART was developed as a part of the Naval Tactical Warfare Database (NWTDB) project. The NWTDB process unites users, system developers, database producers, and data administrators to solve data interoperability problems.

Health Information Resources Service (HIRS)

HIRS is an advanced form of repository in support of the DoD Health Affairs community. Traditionally, a repository contains a knowledge base of information about the organization, its goals, entities, records, organizational units, functional processes, procedures, applications and information systems. HIRS provides these services, but also provides an integrating technology that enables users to access information from a variety of sources. These facilities are provided within the HIRS Virtual Environment independent of which organization information systems are automated and the mix of automation technologies employed. HIRS is freely accessible on the WWW, however, the virtual library provides configuration management type access controls and certain parts of HIRS are password controlled.

The HIRS Standard Model Warehouse is an ISO-PCTE compliant standards-based tool set. The standard CASE tool methodologies of IDEF, CDIF, and OMT are integrated into a common repository. This architecture allows for CASE tool translation, migration to other methodologies (such as from IDEF1X data modeling to Object Modeling Technique) mapping/matching, and integration of multiple models in various tools (including IE:Advantage, ERwin, BPwin, AI0win, Rational Rose, Paradigm Plus, Object Maker, OM Tool), and configuration/model management tools.

Marine Air-Ground Task Force (MAGTF) Data Library/Data Dictionary System (MDL/DDS)

A non-proprietary MS Windows-based tool, the MDL/DDS is used to automate quality specifications and perform data set validations prior to distributing reference data on CD-ROM. The Data Quality Engineering (DQE) tool set has been created from COTS combined with C++ code. A combination of WATCOM (COTS) database and CASE tools are used to automate the data standardization, data mapping/matching, and domain specification processes.

The tool is divided into two major applications with discrete, but interrelated sub-functions called workbenches. The DQE application provides the necessary functions to perform database management and data quality engineering. The DDS application provides data administration functions such as data standardization, mapping/matching, and metadata repository. The DQE Workbench evaluates incoming and outgoing reference data, using a custom procedure editor for creating User-Defined Rules (UDRs) and performing special queries. This automated tool assists with the generation of SQL script. A report utility enhances raw query output with graphs, filters, and text processing options.

The DDS supports DoD compliant data standardization, and holds all required and optional metadata as prescribed in DoD 8320 guidelines. It can be modified to support any set of guidelines. The DDS Workbench performs data standardization functions that include a query by example, filter, search, insert, standard name and access mnemonic generation features. The mapping element option is consistent with the DoD guidelines. This module also supports direct interface mapping as follows:

- Application Element to Application Element
- Application Element to Reference Dictionary Element
- Reference Dictionary Element to Application Element
- Reference Dictionary Element to Reference Dictionary Element

System Administrator support includes window level access security, user privileges, user address records, and password control.

Personal Computer Access Tool (PCAT)

PCAT version 2.1 is a stand-alone version of the Defense Data Dictionary System (DDDS). The DDDS is the primary automated tool that supports DoD Data Administration in developing and managing standard data per DoD Directive 8320.1. PCAT provides a user-friendly method for searching and analyzing all the DoD standard and non-standard data elements and primewords that reside in the DDDS. It provides a mechanism for defining metadata, cross-referencing and consistency checking, and supports the standardization of data element names, definitions, and relationships. PCAT was developed to support data analysis and data administration.

Some of the features of this tool include: list- and keyword-based searches, customized data filters, data element creation, naming convention validation, user-guided thesaurus, reports, on-line help, multi-user access, data import/export, and stand-alone or LAN server implementation. Users can download updated PCAT databases (MS Access) monthly via FTP.

Secure Intelligence Data Repository (SIDR)

The Functional Data Administrator for Intelligence (FDA-I) developed the SIDR Prototype for the DoD Intelligence Community. It is a data standardization tool that permits users with little knowledge of DoD 8320.1-M-1 data standardization procedures to consistently produce standards compliant data. The SIDR 8320 Application is also an information management analysis tool that permits users to quickly research and associate standard and non-standard data to related data, models, applications, documents, and organizations. SIDR enforces compliance with DoD 8320.1-M-1, IDEF0, IDEF1X standards.

SIDR can import data from various tools and applications such as IE:Advantage, ERwin, and the DDDS. Once data has been imported into SIDR, the tool's powerful search engine assists the data analyst in creating DoD compliant standard data. The search engine performs searches against standard and nonstandard data to determine if similar data exists. The tool guides prompt the user to use DoD mandatory fields and flag any data that does not meet DoD 8320.1-M-1 requirements. SIDR also allows new versions of approved DoD elements to be created. This tool also imports non-standard data from legacy systems for researching standard data elements and for traceability. The new standards information developed can be batch loaded directly into the DDDS.

System for Model Analysis, Reporting and Tracking (SMART)

SMART was developed by HQ SSG/ENSD to support data analysis and data administration. It enforces the 8320.1-M-1 and FIPS 184 standards. This Microsoft Access-based application is integrated with Logic Works ERwin (a database design and modeling tool), Microsoft Word, and PCAT SMART can be implemented as a stand-alone or on a LAN server.

Some of the features of the SMART tool include: standard data element creation, data element and model standards compliance validation, integration of model and metadata information, data standardization submission package generation, package archival and tracking, and application of DISA notation to model objects. SMART supports DDDS import/export formats and Microsoft Access MDB file format. It was developed to support the requirements of data analysis and data administration, and adheres to DoD Directive 8320.1, DoD Data Administration, and Federal Information Processing Standards (FIPS) Publication 184, "Specifications for Integration Definition for Information Modeling (IDEF1X)".

Best Practices

Government and commercial tools should be selected based on their inherent utility, compliance with standing directives, and level of acceptance within the DoD community.

Guidelines and priorities should be set for the use of tools in support of specific information management requirements and needs. The dynamics of the tool environment are characterized by active inputs to tool development and continuing update of tool selection guidelines.

Recommended Implementation

	Current ITSG	Projected ITSG			
Not Recommended	**1999**	**2000**	**2001/2002**	**2003/2004**	**Emerging**
	GOTS with COTS Support	Imp Plans	Updates	Updates	COTS with GOTS Support
Activities, Platforms, Operational Environments		Data Base Developers			

Table 8-14. Information Engineering Tool Implementation

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